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AMERICAN MACHINIST

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Vol. 31. 505 PEARL STREET, NEW YORK. No. 17.

Index to Advertisers and Classified Index Following Reading Matter.

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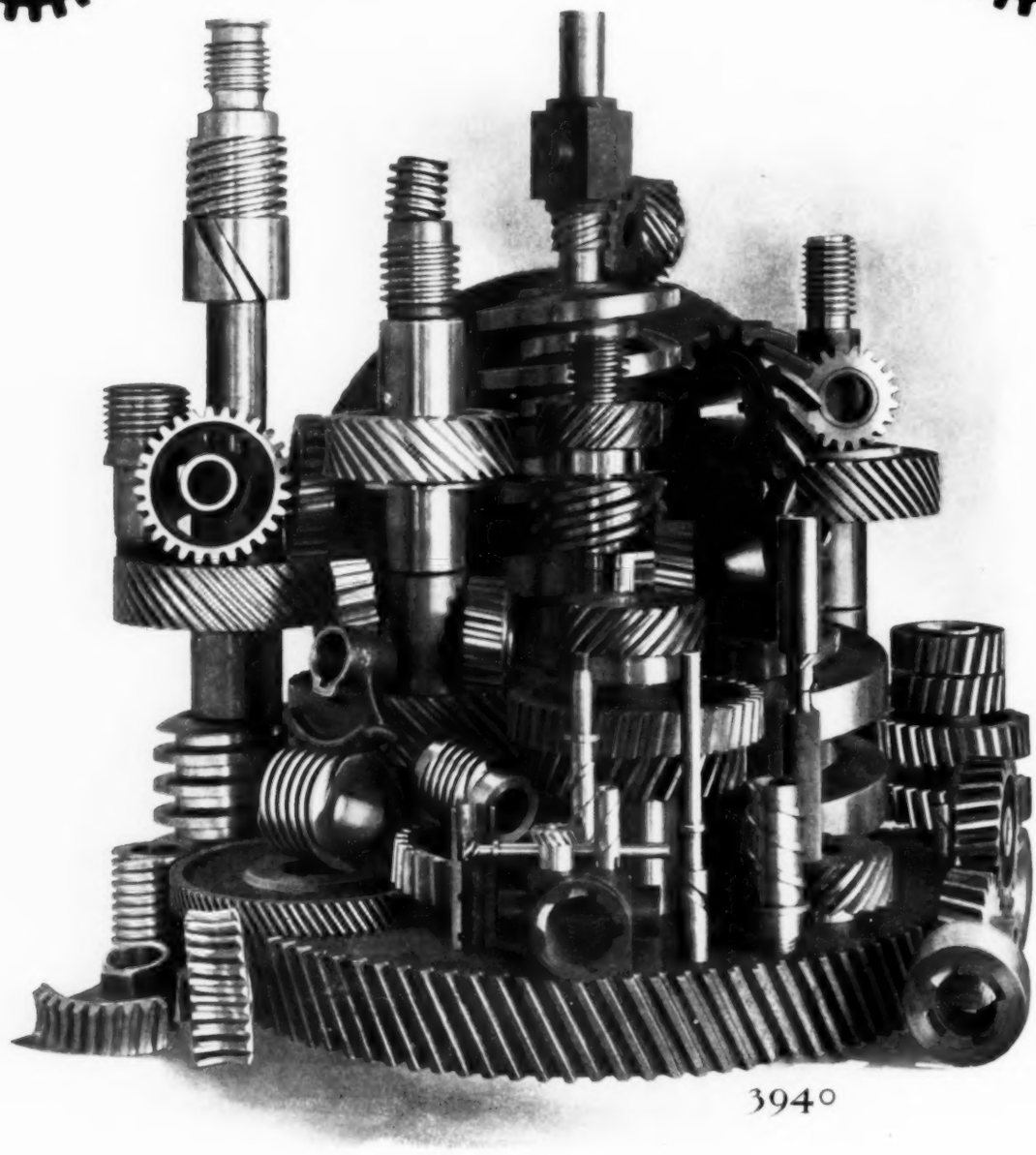

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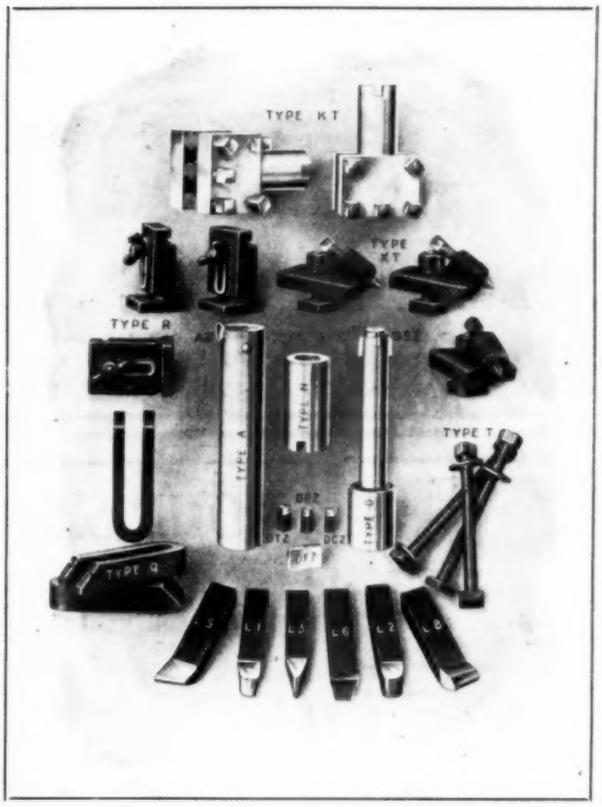

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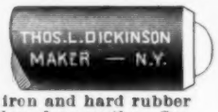

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Joints and Fittings for High-pressure Air

Including Both Screw-thread and Flanged Joints, Metal to Metal Contacts and Packings That Expand Instead of Blowing Out

BY H. V. HAIGHT* AND B. C. BATCHELLER†

In a pneumatic haulage plant where air pressures of 700 to 1200 pounds per square inch are employed the detail work of the design is largely a problem of joints, valves and pipe fittings. Only ordinary care and good judgment are needed in the design of these details; it is the common experience in coal mines that with a pneumatic haulage system which has been carefully designed, constructed and erected, there is actually less trouble from leakage with air at 1000 pounds pressure than with ordinary systems using air at 100 pounds pressure. A plant consisting of an air compressor, an extensive system of piping with valves and fittings, and several locomotives can be made practically bottle tight with air at 1000 pounds pressure without undue trouble or expense. This being the case, it would appear that with reasonable care a compressed-air system for 100 pounds pressure can be made practically bottle tight.

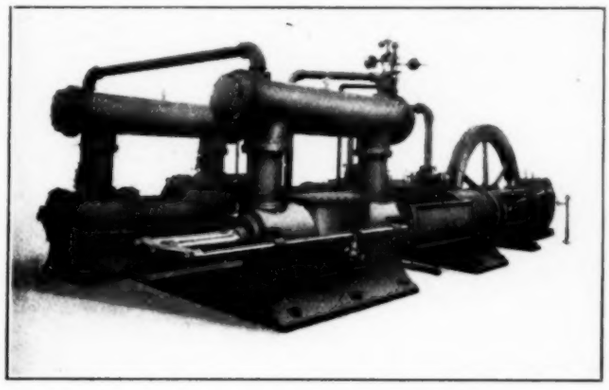


FIG. 1. A FOUR-STAGE AIR COMPRESSOR—TERMINAL PRESSURE 1000 POUNDS

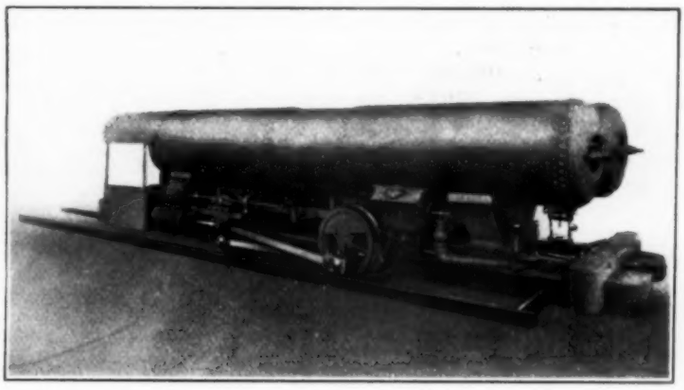


FIG. 2. A PNEUMATIC LOCOMOTIVE STORING AIR AT 800 POUNDS PRESSURE

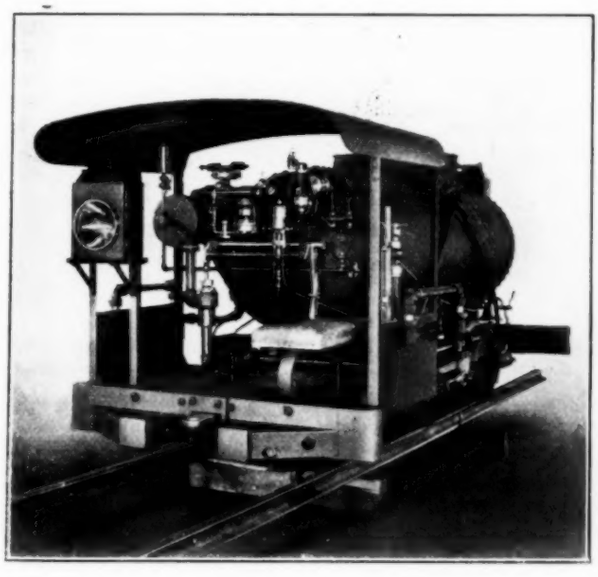


FIG. 3

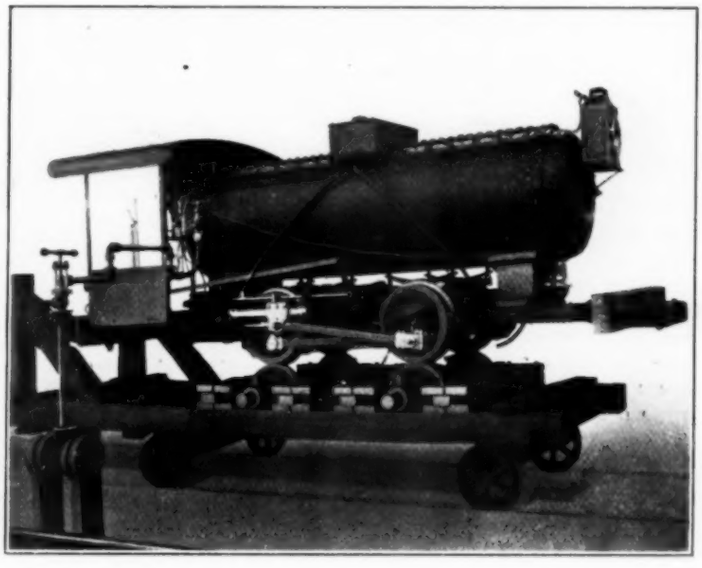


FIG. 4

PNEUMATIC LOCOMOTIVES

The following incident will show how far from this ideal may be the actual conditions in an ordinary mine system with air from 80 to 100 pounds pressure: A coal company told an erecting engineer that one of his firm's compressors, which had been running some time, was not delivering its rated capacity. The machine was rated at 44 cubic feet per revolution; its normal speed was 70 revolutions per minute, thus giving a free air capacity of 3080 cubic feet per minute. The compressed air was used mostly for driving pumps. From figuring the capacity of the air cylinders of the pumps one of the coal company's men had concluded that the compressor was not pumping nearly its rated capacity. The erecting engineer got permission to make a test. One Sunday the pumps were all shut off and it was found that it required 32 revolutions per minute of the compressor to keep the air pressure up to 80 pounds; thus showing a leakage loss of 1400 cubic feet of free air per minute requiring at the steam end of the compressor about 120 indicated-horsepower.

*Chief engineer, Canadian Rand Company.
†Chief engineer, Pneumatic Service Company, formerly chief engineer, Pneumatic Dynamite Gun Company.

It is hoped that a description of fittings which have been successfully used for high-pressure air will be of assistance to those who wish to improve existing piping systems, or to install new systems; whether for ordinary or high air pressures.

As the fittings which I purpose to describe are most of them used in connection with pneumatic haulage plants built by the Canadian Rand Company for coal mines in western Canada, it may be well to give a brief outline of the principal parts of such an installation. A pneumatic haulage plant consists essentially of an air compressor, a pipe line used for both storage and distribution and one or more locomotives.

The Compressor Plant

For coal mines this usually consists of a duplex steam-driven compressor with its boilers and auxiliaries. The air end is four-stage; the terminal pressure is about 1000 pounds per square inch and the intermediate pressures are about 25, 100 and 375 pounds respectively. The steam cylinders have usually balanced Meyer valves; although the Pacific Coal Company, near Banff, has a compressor with compound Corliss steam cylinders. Fig. 1 shows a compressor having duplex Meyer steam cylinders and four-stage air cylinders.

The Pipe Line

The compressed air is delivered into the pipe line which is used both for storage and for distribution. Pipe is cheaper than tanks, even if it is used only for storage, and when large pipe can be used for both storage and distribution it is evidently very much cheaper than separate storage tanks and small distributing pipe. At suitable places along the pipe line are located charging stations for filling the tanks on the locomotives. When the tank is connected to the pipe line and the valve is opened the pressure is equalized at about 800 pounds. With 1000 pounds pressure in the storage line, 150 pounds pressure remaining in the locomotive tanks and with a ratio of pipe line to tank of 4 to 1 the pressure should equalize at 830 pounds.

The Locomotives

Pneumatic locomotives are shown in Figs. 2, 3 and 4. The locomotive carries one or two high-pressure tanks in which air is stored at 800 pounds pressure. From the storage tanks it passes through a series of stop and reducing valves to the auxiliary reservoir where the pressure is maintained at about 150 pounds per square inch. Thence the air is admitted by the throttle to the cylinders.

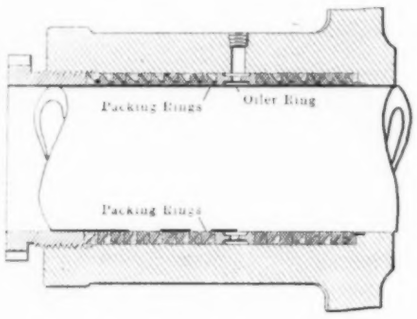


FIG. 7. FIVE-INCH PLUNGER PACKING

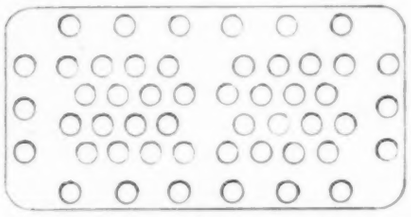
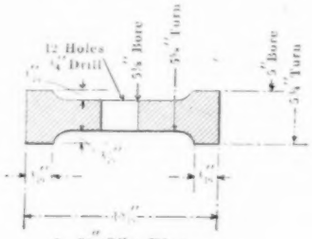


FIG. 9. REVISED LAYOUT OF STUD HOLES IN A TUBE PLATE



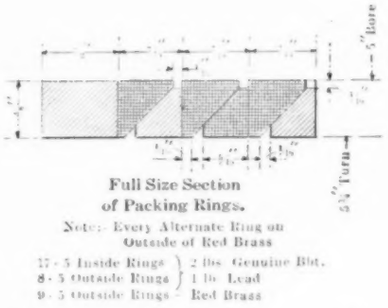

5" Bore
5¼" Turn
Full Size Section of Packing Rings.
Note:- Every Alternate Ring on Outside of Red Brass
17 - 5 Inside Rings } 2 lbs. Genuine Bbt.
8 - 5 Outside Rings } 1 lb. Lead
9 - 5 Outside Rings - Red Brass

FIG. 8. DETAILS OF OILER AND PACKING RINGS

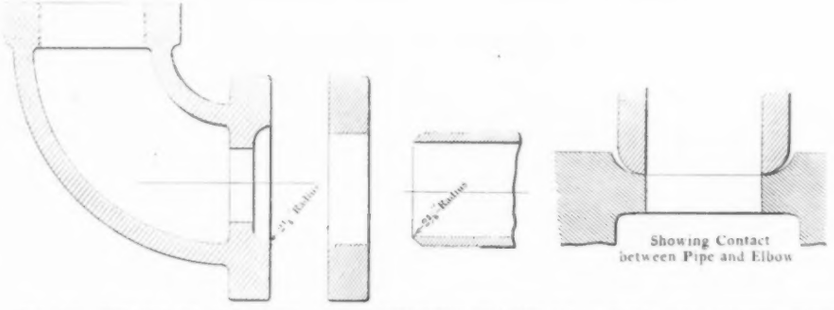


FIG. 10. DETAILS OF AN ELBOW AND COMPANION FLANGE OF A BALL AND SOCKET JOINT

Compressor Joints

The high-pressure fittings and joints of the air compressor are nearly all used in connection with the tank containing the three- and four-stage cylinders. A longitudinal section of this tank is shown in Fig. 5. This shows one of the first machines built; on later machines the pipes connecting the intercooler to the heads have been placed outside the tank for convenience of access. Fig. 6 shows a cross section of the tank on one of the later machines. Referring first to the plunger packing, Fig. 5 shows plungers packed with both piston rings and stuffing boxes; on the later machines the piston rings were omitted as unnecessary. A section of the fourth-stage stuffing box and details of the packing ring and oiler ring, or "lantern," are shown in Figs. 7 and 8.

It will be seen that the inner rings are

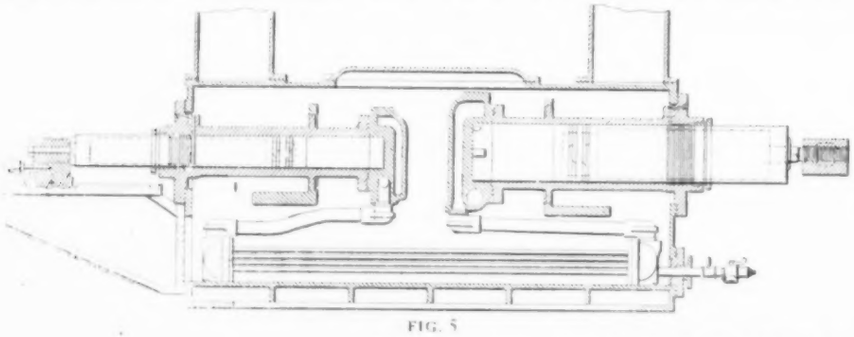


FIG. 5

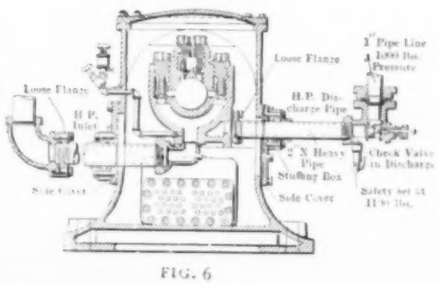


FIG. 6

TANKS CONTAINING THIRD- AND FOURTH-STAGE CYLINDERS

all of soft babbitt (two pounds of genuine babbitt to one pound of lead) while half of the outer rings are of babbitt and the rest of red brass. If the outer rings were all of babbitt they would wedge against the outer wall so tightly that it would be very difficult to remove the packing. On the first machine the plungers were simply turned smooth, but the erecting engineer reported that the packing wore away quite rapidly until the plungers had begun to wear smooth. On later machines the plungers were ground and gave no trouble. This packing has given excellent results on large plungers. The position of the oiler ring may perhaps be criticized and it would probably be better to place it nearer the stuffer. Plastic packing was also tried with these plungers. Three grades of commercial plastic packing, each consisting of grains of soft alloy packed in "sausages," were tried on a small machine with a 2⅜-inch plunger. Two of the packings would not hold a pressure of 800 pounds; the third kind proved satisfactory on small plungers. This space for packing was the same as for metallic rings; namely, ⅜-inch all around the plunger.

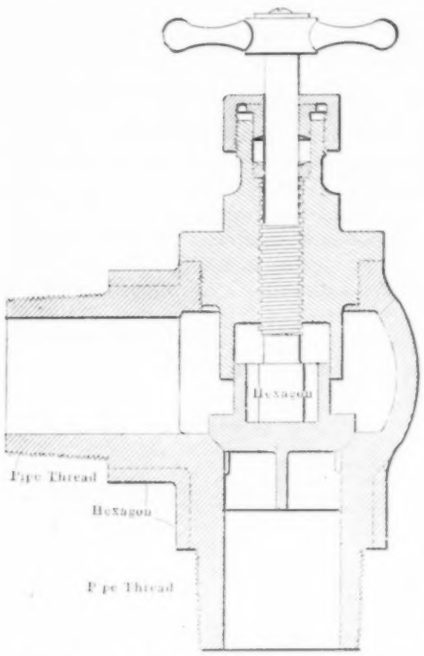


FIG. 11. A HIGH-PRESSURE CHECK AND STOP VALVE

FIG. 13. A 4-INCH SPECIAL EXTRA HEAVY COUPLING

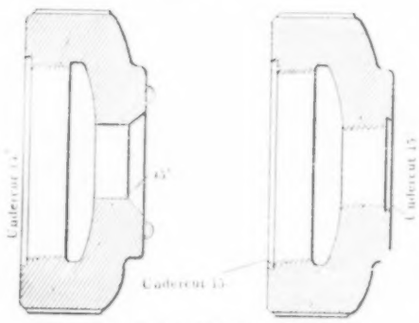
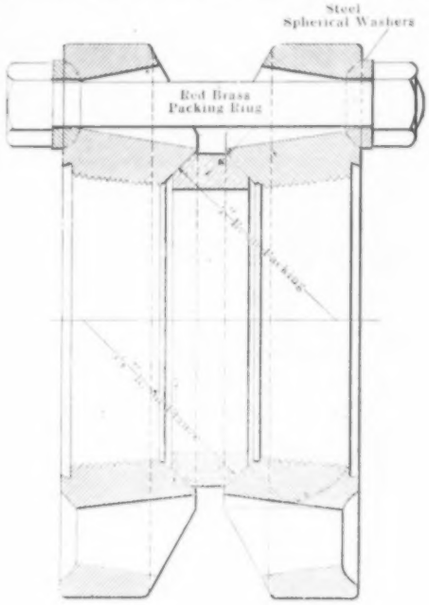


FIG. 12. TWO STYLES OF REDUCING COUPLINGS

This same kind of plastic packing was afterward used on large five-inch and nine-inch plungers, but the space for the packing was made ¾ inch. In this case it did not give altogether satisfactory results; there was liable to be a little more packing on one side of the plunger than on the other and the stuffer could not be screwed up hard enough to pack it all around. The use of a few rings of soft packing in conjunction with the plastic metallic packing might distribute the pressure evenly and overcome the difficulty, or, it may be, if only ⅜ or ½ inch space were allowed for the packing the stuffer could be screwed up tight enough to distribute the packing equally around the plunger. On the whole, however, babbitt rings have been more satisfactory for large plungers.

The intercooler shown below the cylinders carries a working pressure of 375 pounds per square inch. It consists of copper tubes ¾ inch outside diameter and about 1/16 inch thick, expanded into steel-tube plates ⅞ inch thick. These tube plates are secured by studs to headers. Referring to the cross section, Fig. 6, it



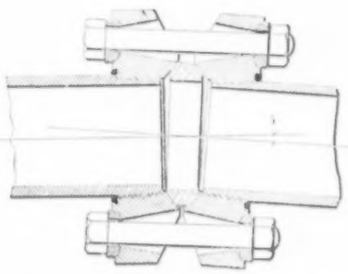


FIG. 14. A FLANGE UNION FOR 1000 POUNDS AIR PRESSURE

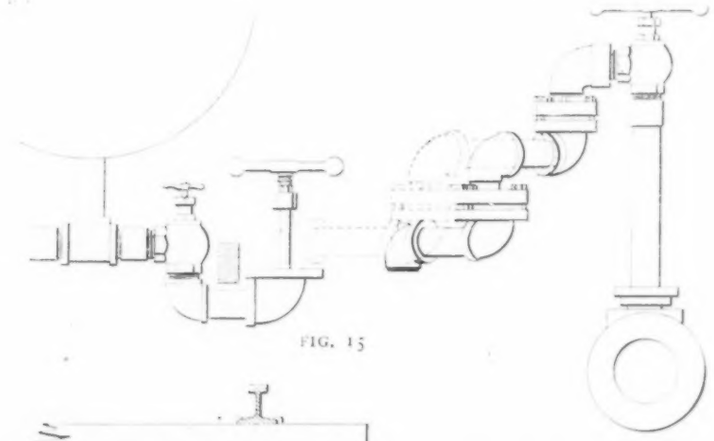


FIG. 15

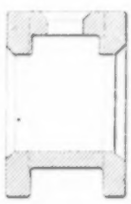


FIG. 16

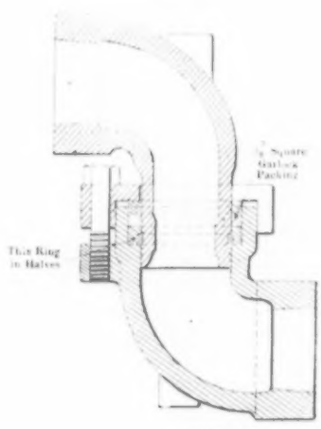


FIG. 17

CHARGING DEVICE, TEE AND SWING JOINT

will be seen that at each corner of the plate there is a stud which comes almost exactly in the corner. Professor Sweet's rule in regard to placing studs on a rectangular plate such as this is: "The studs should not be placed right in the corners." As a matter of fact, with the arrangement shown the corners bent down causing leakage. The layout of studs was changed to that shown in detail, Fig. 9, which gave no farther trouble. The gasket between the tube plate and header is made of copper wire about 3/16 inch in diameter. A good grade of sheet packing might, however, serve the purpose all right.

A rather peculiar difficulty was experienced with the tubes of one of these intercoolers. In this case the tubes were made of brass, and although they stood the water test at the shops all right, it was reported when the machine was started that some of them were cracked. The matter was taken up with the manufacturers of the tubes, and their explanation was that the tubes were not annealed, that we did not specify annealed tubes, or state what they were to be used for, and that they had sent us unannealed tubes. They stated that these were liable to crack in transit, or even in the store-room. We could not imagine any purpose for which such tubes would be suitable, and concluded that in future it would be safest to use copper tubes.

Compressor Fittings

The fittings shown in Fig. 6 may next be described. A very convenient fitting is the ball and socket joint with loose flange, shown where the high-pressure inlet is attached to the elbow outside the tank, and also where the high-pressure discharge is attached to the head. A detail of the elbow and companion flange is shown in Fig. 10. The thread is not subjected to air pressure, so it is made straight and the flange screwed on by hand. As the joint is against the end of the pipe, there is only one joint instead of two or three as in the case of an ordinary companion flange. The ball and socket feature makes the joint tight even if the parts are not in line. The flange being loose can be readily removed when it is necessary to take that off the side cover of the tank. It is this feature in particular which makes this joint so convenient where it is necessary to slip anything over the end of the pipe before the joint is made. Extra heavy pipe was used in making these joints in order to have sufficient thickness left after threading. Seamless tubing would probably be better than lap-welded pipe, as there would be no seam coming right in the joint. However, extra heavy pipe did not give any particular trouble on this account. It will be noted that the radius at the end of the pipe is made slightly less than the radius of the corresponding socket. This gives in effect a line contact at the smallest diameter of the joint so that it is not necessary to screw up the bolts very tight in order to develop sufficient pressure per square inch between the opposing surfaces to hold the air pressure. It may be asked why the companion flange to the check valve was not made in the same way. The reason is that the latter is a field joint and it would not be convenient to have the end of the pipe specially threaded and faced.

It will be noted that the stuffing boxes for the pipes are made separate from the side covers for the tank. On the first ma-

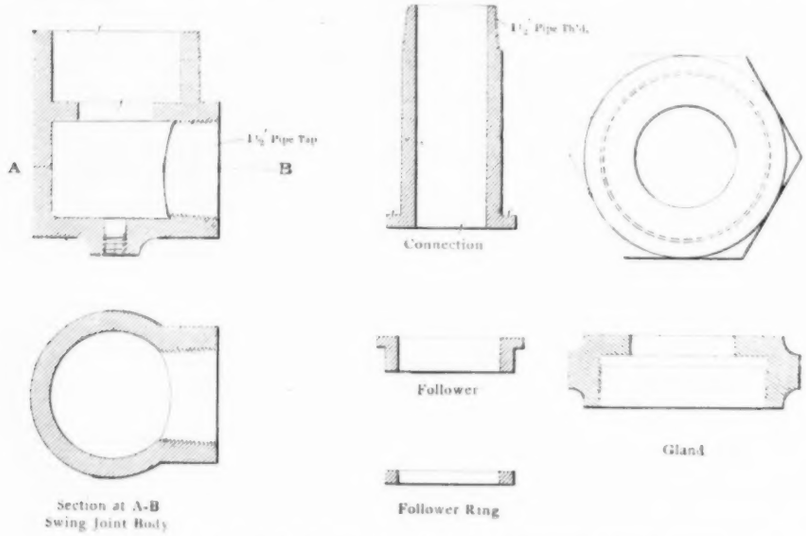


FIG. 18. DETAILS OF A 1½-INCH "DECK" HIGH-PRESSURE SWING JOINT

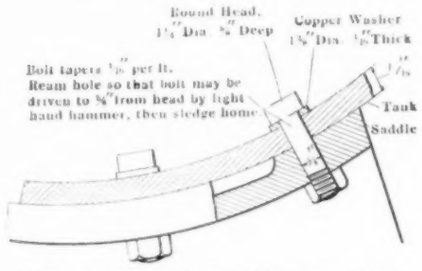


FIG. 21. PNEUMATIC LOCOMOTIVE BOLTS

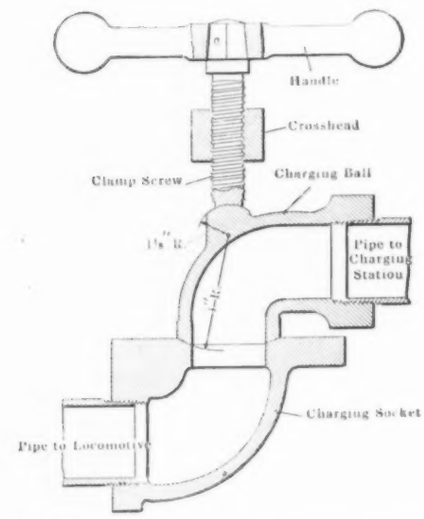


FIG. 19. BALL JOINT WITH CLAMPING SCREW FOR A CHARGING STATION

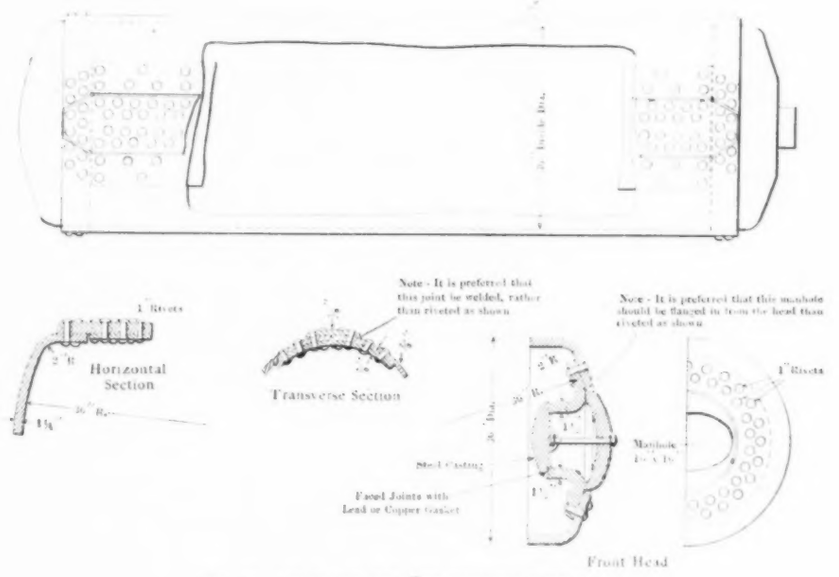


FIG. 10. AIR TANK FOR 800 POUNDS PRESSURE

chine the stuffing boxes were cast on the covers, but it was found that after the cylinders were assembled in the tank the pipes did not always come right in line with the stuffing boxes. The covers are now cast plain and are drilled for the pipes after the other parts are assembled and the pipes located.

The style of check valve shown in the discharge pipe is used with slight modifications for either a stop or check valve on compressor, pipe line and locomotive. A section of one of these valves is shown in Fig. 11, and it will be seen that it is the same style as an ordinary locomotive check valve. The stem may be used to turn the disk and thus grind out any dirt which may have lodged on the seat, or the valve may be locked shut. When used as a stop valve the hexagon on the stem is turned off round. The stem of a stop valve of this style gave way under pressure, shortening and increasing in diameter and changing the pitch of the thread. The stem that failed was made of yellow brass bar. It was replaced by a cast-bronze stem which stood all right. The stress in the stem where it failed figures out about 4000 pounds per square inch with 800 pounds pressure. The bodies are made of red brass and the stress in the body at *T*, assuming the shape to be spherical, figures out 2000 pounds per square inch. Neither of the above stresses were, however, figured out when the valves were designed; they were simply proportioned according to the judgment of the designer.

Pipe Line Fittings

As explained above, quite large pipe is used in order to act as storage; the sizes most commonly employed being 4-, 5-, or 6-inch. Very much smaller pipe would do simply to transmit the air, so that it is customary to use 1½- to 3-inch pipe from the compressor to a point outside the engine room where the large pipe begins. Small pipe is also used where it is necessary to pass under or over the railroad track, or at any place where it would be difficult to get around with large pipe. Fig. 12 shows two different styles of pipe caps or reducing couplings for connecting 6-inch pipe to 2½-inch pipe. The companion flange for the flange connection is made the same as the one shown on the check valve in Fig. 6. For this small connecting pipe extra heavy pipe and steel ammonia elbows are used.

As there is usually at least a mile of large pipe, the question of cost becomes an important one; while extra heavy pipe would doubtless be quite satisfactory, it is stronger than necessary, and is quite expensive. Standard pipe is hardly strong enough. There is, however, a grade of pipe between standard pipe and extra heavy known as full-weight, or line pipe. What is known as standard pipe is actually about 10 per cent. lighter than the weights given in standard lists. Full weight, or line pipe, is, however, of the dimensions and weights shown in lists for standard pipe. (This is the explanation a pipe salesman gave me.) This does for storage pipe very well, although there have been a couple of instances where some lengths of this pipe split in service. In one case a piece of 5-inch pipe carrying 900 pounds pressure burst in cold weather without apparent cause. In another case a car ran into a 4-inch pipe carrying 850 pounds. It broke where it was struck and also at the end, five lengths beyond where it was struck. The results of the split were not, however, very serious. The H. K. Porter Company got a special pipe for this purpose made from selected skelp and very carefully worked. This seems to give most satisfactory results.

The couplings used are of a special type made extra heavy with long threads and recessed for calking with lead. A 4-inch coupling is shown in Fig. 13. If the pipe is screwed up properly there are, however, no joints which it is necessary to calk with lead. When screwing up 4-inch pipe, for instance, there will be a gang of about seven men, six of them with three pairs of heavy pipe tongs screwing in the pipe and one man at the joint. The pipe which is already screwed up is held from turning by a clamp.

It is not found necessary to make any special provision for expansion in these pipe lines.

For flange unions in the pipe line the ball-joint flange union shown in Fig. 14 is a very handy fitting. As it permits a movement of 5 degrees in any direction, it may be used wherever there is a small change in the direction of the pipe line. Where a greater change in direction is required the pipe is bent; if the bend is not exactly correct the difference may be conveniently made up by one of these flange unions. A style of high-pressure flange union very commonly used has a babbitt packing ring; they are liable to leak after the pressure has been pumped up and lowered again, and have to be

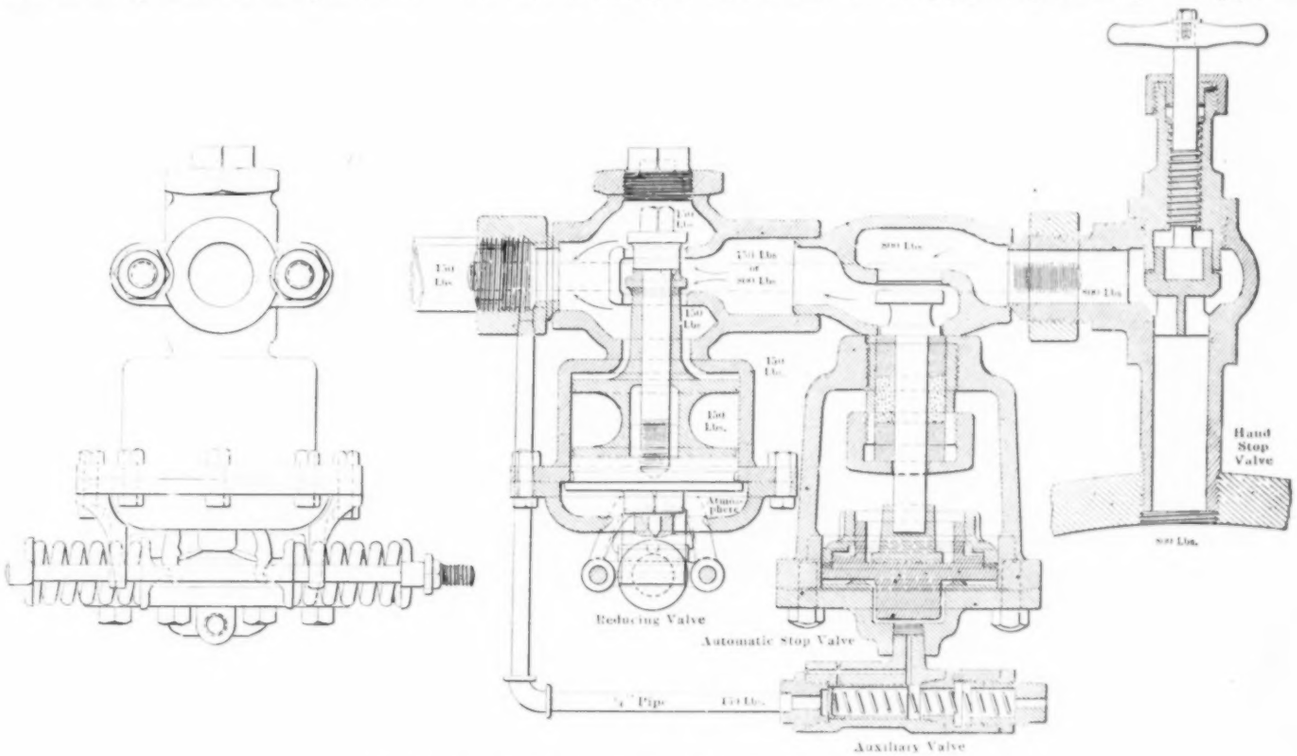


FIG. 22. PNEUMATIC LOCOMOTIVE STOP AND REDUCING VALVE

tightened occasionally. The pipes must also be exactly in line, or they will leak. With the flange unions shown in Fig. 14 these difficulties do not exist. The erecting men like them very much on account of their convenience when laying crooked lines.

At suitable points in the pipe line, say about a mile apart, are located stations for charging the tanks on the locomotives. Fig. 15 shows a charging station and the charging device on the locomotive. The charging station consists of a tee, a charging valve, two swing joints, the "ball" of a ball-and-socket joint, and three short pieces of pipe. The charging connection on the locomotive consists of the "socket" of the ball-and-socket joint, a clamping screw, a check valve, and the necessary pipe connections to the tank.

A flange tee for a charging station is shown in Fig. 16.

The check valve on the locomotive is shown in Fig. 11. The handle is very essential on this valve; if a little dirt lodged under the seat in charging the locomotive all of the air would blow out of the tank before the valve could be fixed. With the handle the disk can be turned to grind out the dirt. The charging valve shown is similar to the check valve, but with a round end on the stem instead of a hexagon one, and with a long "double-ball" handle. A swing joint is shown in Fig. 17. This, it will be seen, combines a swing joint and two elbows. The use of the split ring enables it to be put together without having the stuffer, rings, etc., large enough to put on over the large end of the elbow.

Fig. 19 shows the ball-and-socket joint made by Deck Brothers, Buffalo, which gives good satisfaction for high-pressure air. It is made of brass and has a screwed instead of a bolted follower. The male half is a nipple instead of an elbow, so it does not require the split ring. An elbow must be used with this swing joint to make it complete for use on a charging station.

Fig. 19 shows the ball and socket joint and clamping screw. With the charging station shown the locomotive may stop within about 3 feet on either side of the station, that is, at any point in a distance of about 6 feet. A common form of charging station used in the coal mines of the United States consists of three "Moran" ball joints, a special threaded union to connect to the locomotive, a charging valve and a "bleeder," which is a small valve to let the air out of the piping after the charging valve is closed so that the union can be unscrewed with a wrench. As the ball joints permit movement in a vertical as well as in a horizontal direction, they are usually counterbalanced with a rope, pulley and weight. With this style of charging station it is necessary to stop within a foot or two. The charging station illustrated herewith does away with the necessity of counterweight, bleeder and wrench, allows greater latitude in stopping, and thus reduces the time required for charging from one or two minutes down to half a minute.

Locomotive Joints and Fittings

The storage tanks on the locomotives are designed for much higher fiber stresses than would be permissible in a steam boiler. There are no strains due to unequal expansion, no corrosion due to bad water, no danger of low water allowing the plates to be weakened by heat, no such tremendous storage of energy as in the hot water in a boiler, and no chance for a large increase in pressure. For these reasons the tanks are designed for fiber stresses of about 20,000 pounds per square inch. The 36-inchx10-foot tank shown in Fig. 20 has a riveted joint of 85 per cent. efficiency, and with 800 pounds air pressure the stress figures out 19,360 pounds per square inch. Tanks 30 inches in diameter with welded longitudinal seams for 1000 pounds working pressure were made ¾ inch thick, which figures out 20,000 pounds per square inch fiber stress, or, if only 90 per cent. is allowed for the welded joint, 22,222 pounds per square inch. Tanks 32 inches in diameter with welded longitudinal seams for 1000 pounds working pressure were made 13/16 inch thick, which figures out 19,700 pounds per square inch for a 100-per cent. joint.

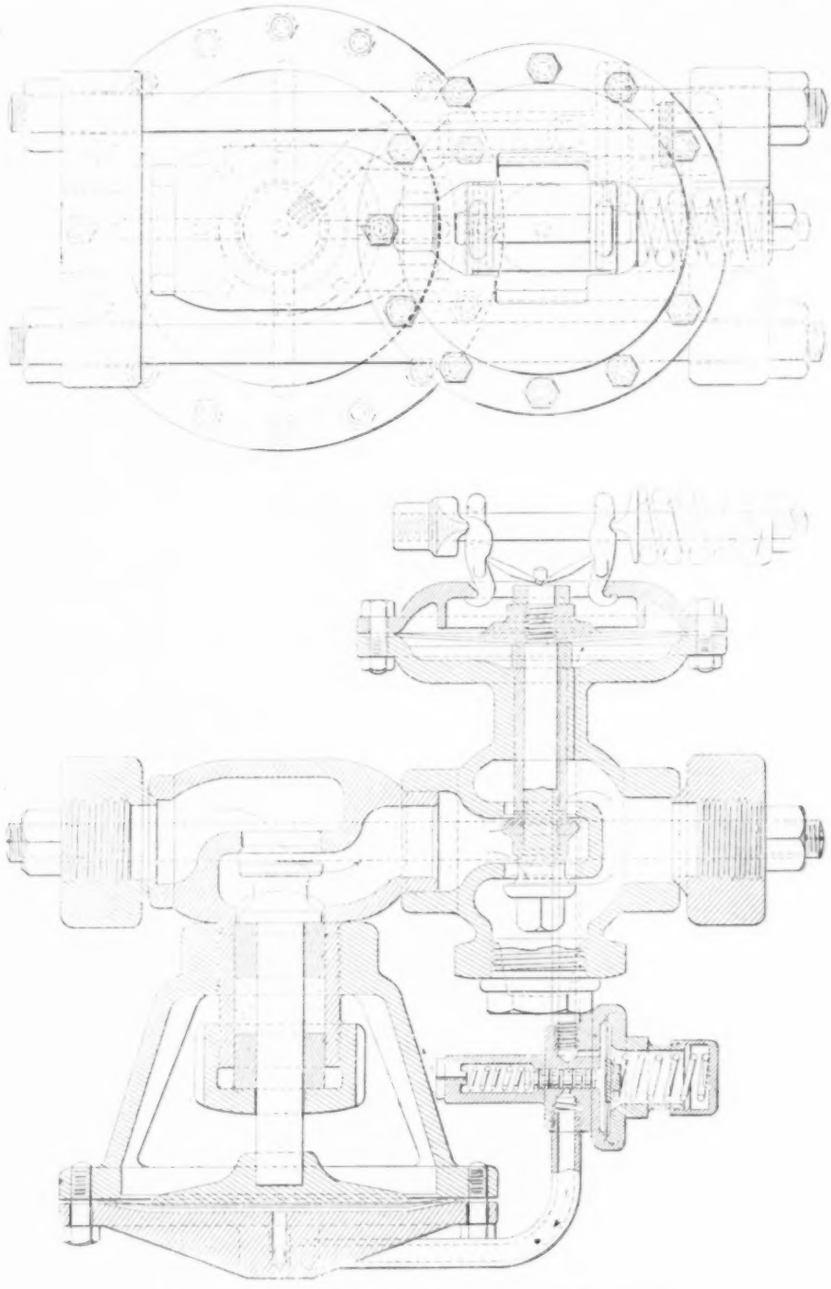


Fig. 23. Diaphragm Construction of Foster Valve

These tanks were all made in England and were fine looking pieces of work; heads and manholes were evidently flanged by hydraulic press, and the welded seams were scarcely visible. The tanks with

welded longitudinal seams were cheaper than those with riveted longitudinal seams.

The method of fastening the tanks to the saddles is important. At one of the coal mines in Pennsylvania I was told that three different methods had been used on their locomotives. The first locomotive

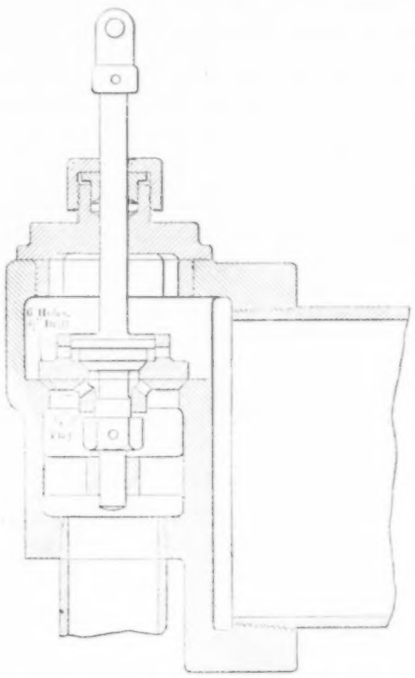


FIG. 24. THROTTLE VALVE FOR A PNEUMATIC LOCOMOTIVE

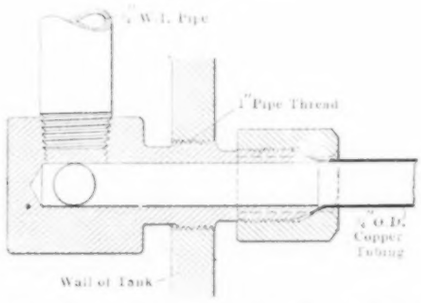


FIG. 25. TANK CONNECTION FOR ¼-INCH COPPER TUBE

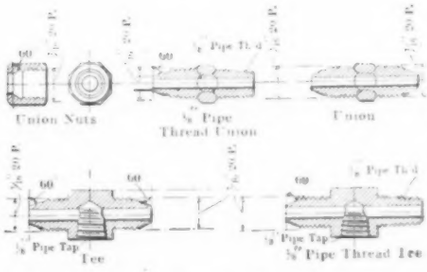


FIG. 26. UNIONS AND TEES FOR ¼-INCH COPPER TUBE

had the saddles secured to the tank by cap screws with straight treads, the second one had cap-screws with taper threads, and later ones had taper bolts. The straight threaded cap screws leaked and were finally replaced by taper bolts. The Canadian locomotive had taper bolts put in as shown in Fig. 21. It was not found necessary to even calk a single copper washer.

The stop and reducing valves between the storage and auxiliary tanks are a most vital part of the locomotive. Fig. 22 shows one of these sets of the latest design. It consists of a hand stop valve, an automatic stop valve with its auxiliary valve and a reducing valve. Of the set shown in Fig. 22 the Foster Engineering Company furnished the automatic stop valve and the reducing valve, but the hand stop valve and the auxiliary valve were built in the Canadian shops.

The hand stop valve is only used in case the other valves require packing, or minor repairs. It can be used, however, instead of the automatic stop valve or instead of the reducing valve if either of them should be temporarily disabled. The automatic stop valve shuts off the high-pressure air when the pressure rises to 160 pounds in the auxiliary tank, and opens again when the pressure falls to 140 pounds, thus protecting the reducing valve from wire drawing when little or no air is being used. Ordinarily it will close just after the throttle closes and open just after the throttle opens, thus relieving the reducing valve when the locomotive is standing. The reducing valve is perfectly balanced, there being no differential unbalanced area as in the case of an ordinary balanced throttle valve.

It will be seen that this set of valves is of the piston construction throughout; that is, there are no diaphragms. The first valves made by the Foster Engineering Company had diaphragms in all the valves as shown in Fig. 23. At several mines in Pennsylvania which I visited there was complaint of diaphragms breaking. The matter was taken up with the Foster Engineering Company, with the result that on the Canadian valves they eliminated the diaphragms, first on the auxiliary valve and the automatic stop valve and then on the reducing valve. In reply to a recent inquiry for their opinion as to the value of this change the Foster Engineering Company wrote:

"We agree with you that the piston construction is a radical improvement over the old diaphragm construction for this service. We have noted in the past that where diaphragms are used there is a tendency to crystallize and destroy the life of the diaphragms, practically throwing the valve, after some little time, out of commission—a condition that is, of course, not experienced in the use of the piston-actuated type. For this reason we believe the piston-actuated type in actual service will outlast the diaphragm type ten to one."

After passing the reducing valve, the compressed air can no longer be considered as at high pressure, but the style of throttle valve may be of interest. It is shown in Fig. 24, and is of the pilot-valve type; both disks being well guided. It has been found to hold the pressure well,

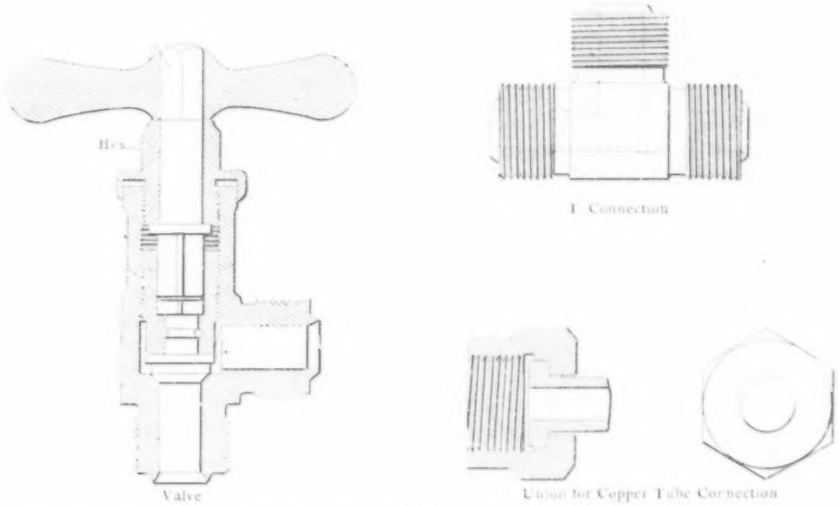


FIG. 27. UNITED STATES NAVY VALVE AND FITTINGS FOR 3000 POUNDS AIR PRESSURE

to give good control and to work easily. This is practically the same design as the H. K. Porter Company uses. The body of the valve forms also an elbow and a head for the auxiliary tank.

A few miscellaneous high-pressure fittings are also illustrated. Fig. 25 shows how a coil of copper pipe in a tank is connected to the exterior piping. The fitting shown combines union, elbow, tank connection and connection to the copper tube. The fitting shown was used for only 350 pounds pressure, but would probably be good for 1000 pounds pressure or more. The manner of connecting to the copper tube is the same as used in automobile fittings for ¼-inch copper tube (see Fig. 26). This form of connection deserves to be better known; it requires neither threading nor soldering of the pipe; is easily connected and will hold almost any pressure. It looks as though it would be a good way to connect lead pipe to faucets.

Fig. 27 shows the type of fittings used

in the United States navy for torpedo service where air pressures up to 3000 pounds are used. Note particularly the knife-edge joints and the neat way of avoiding a stuffing box around the valve stem. In reference to knife-edge joints it will be seen that the rule is: The higher the pressure the narrower are the joints.

Conclusions

From experience with the joints and fittings described above it appears safe to draw the following conclusions in regard to air piping:

1. The regular taper pipe thread is a very satisfactory permanent joint. In this connection the following quotation from the Crane Company catalog will be of interest:

"The screwed joint, when properly made, has, to the best of our knowledge, given complete satisfaction, and we are now disposing of more of these for power-plant purposes than all of the other styles of joints combined.

"Taking up the objection that cutting the thread on pipe weakens it, we will say in explanation of this that the part of the pipe where the thread is cut is always strengthened by the flange or fitting into which the pipe is screwed, and, in many destructive tests which we have made the pipe has never burst where the thread has been cut, but always burst longitudinally some distance from the thread; nor do we remember of ever having received a complaint of the pipe giving way at the thread.

"We make high-pressure joints as follows:

"The flanges are screwed up by power on a long taper thread cut to a true standard, until the pipe projects through the flange, great care having been taken in the tapping of the flange and the threading of the pipe to the correct size, so that same will screw up to the shoulder in the flange and not expose any part of the thread, which would form a weak point in the pipe line. We also take the greatest care to have the threads perfectly clean, which is one of the secrets of making a tight-screwed joint. This matter, we think, has been overlooked by a majority of mechanics in this class of work. The length of pipe is then placed in the machine and the ends of the same turned off flush with the face of the flange. A light cut is also taken off the face of the flange at the same time to insure its face being perfectly square with the pipe."

2. Fittings should be heavy to permit of screwing the pipe in very tight and to resist deformation under pressure. Crane Company also lay special stress on having screwed flanges of good material and very strong.

3. The number of joints should be kept down to a minimum. It will be noted that practically all of the fittings illustrated are combination fittings, thus reducing the number of joints.

4. Flanged joints and threaded unions should preferably have metal-to-metal joints with narrow faces and may preferably be made ball-and-socket type. Where the end of the pipe must be accessible the loose-threaded flange is a very convenient connection.

5. Valves should preferably be of the angle type, with narrow metal-to-metal joints and with the disk well guided. From the design of the Navy valve it appears possible to avoid the use of stuffing boxes around the valve stems, which is a source of a great deal of leakage with common valves.

H. V. Haight.

The Rapieff Flange Joint for High and Low Pressures

Flanged joints for steam, water, air, gas and other fluids under pressure, are usually made tight by bolting a thin, flat gasket of some soft material between the faces of the flanges. Such a joint is shown in Fig. 1. The material used for the gasket is commonly rubber, compounds of rubber with other substances—asbestos, paper, lead, white-lead, etc. We depend upon the compression and flow of the gasket to fill the space between the flanges and friction to hold the gasket in place. If the space is completely filled and the gasket is held in place, then the joint will not leak. Usually the gasket is made broad, covering the entire face of the flange, and the force of the bolts drawing the flanges together is distributed over a large area of gasket. It frequently happens, however, that the bolts must be screwed up very hard to give sufficient pressure per square inch on the gasket to make the joint tight; this is especially true if the faces of the flanges are rough or not parallel. As a result, flanges have to be made much thicker and bolts much larger than are required by the longitudinal strain due to the pressure of the fluid alone. The strength of the flange is usually determined not by the fluid pressure, but by the possible strain of the bolts, and it is not uncommon to see a flange broken or threads stripped from the bolts in a vain endeavor to make the joint tight.

In the case of high-fluid pressure it is common practice to increase the pressure per square inch on the gasket by making it narrow and not having it extend across the entire face of the flange. The gasket must be placed inside the bolt circle, and, as a result, if the flanges are not extra thick, there is great danger that the strain of the bolts will break them. A joint of this kind is shown in Fig. 2.

Flat Gaskets Blow Out

It often happens with high pressures that sufficient friction cannot be obtained between the gasket and the face of the flanges to hold the former in place, resulting in the gasket being blown out. This result can be prevented by placing the gasket in a groove or counterbore in the face of one of the flanges with a tongue on the opposite flange to correspond, as in Fig. 2, but such an arrangement does not overcome the other objections to a flat gasket.

If the two flanges must be at a fixed and definite distance apart, the use of a flat gasket leads to much difficulty, since its thickness depends upon the force with which the bolts are screwed up. One part of the gasket may be softer than another, or there may be irregularities in the faces of the flanges, requiring the bolts to be screwed harder on one side than the other, in which case parallelism between the flanges cannot be maintained. At best, the thickness of the gasket is an indeterminate quantity.

An analysis of these troubles and their causes leads us to the conclusion that a flanged joint with a flat gasket is irrational, especially for high pressures, and that its only redeeming features are simplicity and cheapness.

The Dynamite Gun

A great deal of ingenuity was expended about 15 years ago in designing the pneumatic dynamite gun, six of which were built for the United States Government, and erected for the defense of our harbors. The guns were eventually consigned to the scrap heap, but there were some features of their construction that deserve to live and have a prominent place among the useful devices of the mechanical arts. I have particularly in mind the method of making the joints in the pipes and castings that were a part of the gun and the gun reservoir. These joints were subjected to an air pressure of 1000 pounds per square inch in the gun, and 2000 pounds in the storage reservoir. They were easily and quickly made by ordinary mechanics and were invariably tight. The joints were designed by the late Captain John Rapieff, who designed the gun. One of them is shown in Fig. 3.

Just inside the bolt circle a groove of peculiar shape, *a b c*, is turned in the face of each flange, forming an annular space for the packing when the flanges are bolted together. Into the annular space thus formed, a ring of round rubber-cord is laid, and the two flanges are bolted up metal to metal. The cross-sectional area of the grooves is made slightly less than the sectional area of the rubber cord, so that when the flanges are bolted together the rubber is slightly compressed into the form of the grooves and the surplus rubber flows into a narrow space *d*, between the flanges, that is open into the interior of the pipe. This space *d* is made about 1/16 inch wide. The fluid pressure acts against the thin lip of the rubber *c*, tending to force it back, putting the entire ring of rubber under static pressure, and sealing the joint at *c*. Thus the higher the pressure the tighter is the joint, which is not true in the case of a joint with a

flat gasket. Since the flanges come in contact, there is no tendency to bend or break them in screwing up the bolts. The bolts need only be screwed tight enough to bring the flanges together, for the tightness of the joint does not depend upon the force with which the bolts are screwed up.

The rubber gasket ring is shown in Fig. 4. It is made from rubber cord that can be bought by the yard and made into rings as required. A splice is shown at *f*, which is made by cutting the cord obliquely and joining the ends with rubber cement. The ring should have the same diameter as the grooves in the face of the flanges. Rubber cord ½ inch diameter is large enough for the largest joints, and it is not convenient to use cord much less than ¼ inch in diameter. The rubber should be of good quality, soft, and preferably what is known in the trade as "pure gum." When a joint is made in a horizontal pipe, the rubber ring can be held in the groove of one flange by means of rubber cement, while the other flange is being brought up into position. The joint shown in Fig. 3 was used when exact alinement of the bolted parts was not required. In joining together some parts of the gun—for example, sections of the barrel, alinement was important, and to secure that, the joint shown in Fig. 5 was used, in which there is a counterbore and tongue.

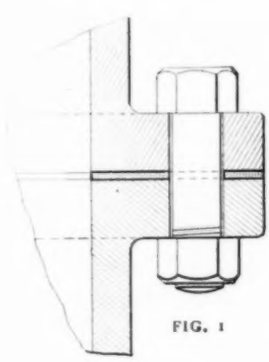


FIG. 1

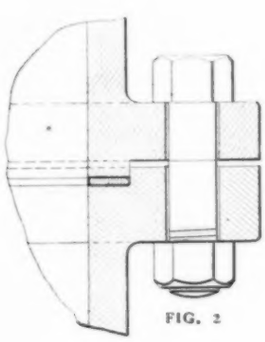


FIG. 2

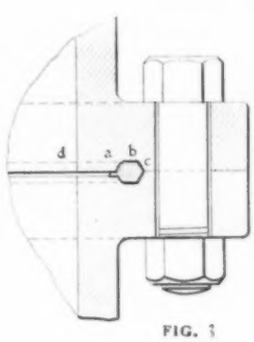


FIG. 3

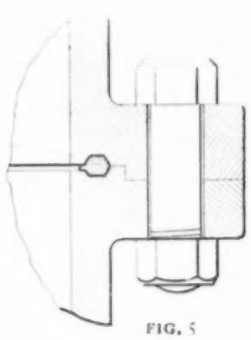


FIG. 5

FIG. 4

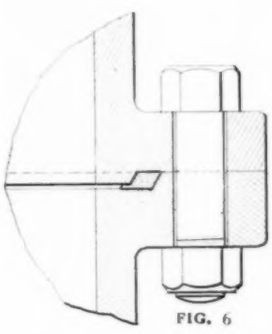


FIG. 6

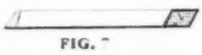


FIG. 7

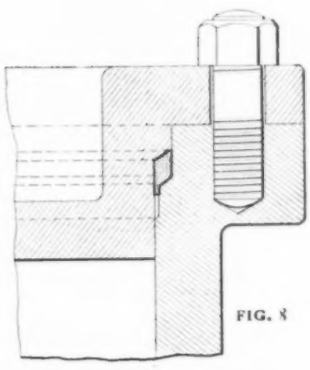


FIG. 8

FIG. 9

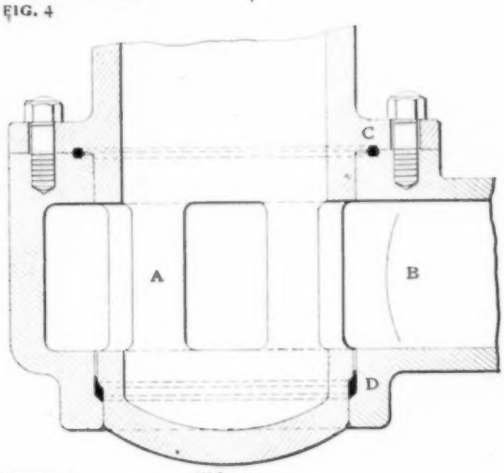


FIG. 10

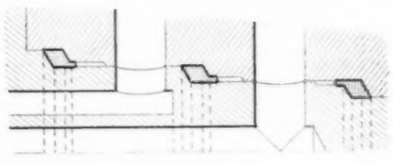


FIG. 11

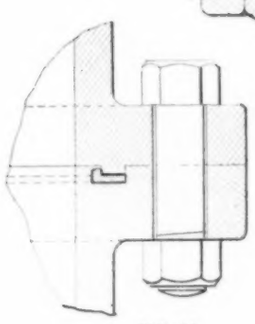


FIG. 12

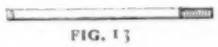


FIG. 13

THE RAPIEFF JOINT

USING A DIFFERENT PACKING RING

Another form of the Rapieff joint is shown in Fig. 6, and a section of the rubber ring in Fig. 7. This has some advantages over the joint shown in Fig. 3, since there are only plane and conical surfaces to be machined instead of an irregular shaped groove. The rubber ring can either be molded or be cut in a strip from a flat sheet, and then made into a ring by splicing the ends.

The important point in making all of these joints is to have the section of the space for the rubber between the flanges slightly smaller in area than the section of the rubber before it is put between the flanges, and to provide a narrow space for the surplus rubber to flow into, which must be on the side toward the interior of the pipe. The rhomboidal packings and the conical surface *b c*, in Fig. 3, were made with an angle of 60 degrees.

Still another form of the Rapieff joint used in the pneumatic gun is shown in Fig. 8. This shows a head bolted to a cylinder. The rubber packing ring is not placed between the flanges in this case, but within the cylinder and on the portion of the head that projects into the cylinder. In making this joint the rubber ring should be stretched over the cylindrical part of the head in order to hold it place while the head is being entered into the cylinder. The rubber ring should be wider and thinner than the space it is to occupy after the head is bolted up. Talc powder can be used to advantage on the

rubber while sliding the head into place, to prevent the rubber from sticking. Fig. 9 shows the form of the ring before it is inserted.

Packing Two Shoulders

With the flat gasket it is practically impossible to make two joints at two shoulders on the same piece and have them both tight, but with the Rapieff joint this problem presents no difficulties. An example is shown in Fig. 10. A lantern casting *A* is bolted by means of a flange to an annular casting *B*. To prevent the escape of fluid under pressure, a rubber-ring packing *C* is used at the joint of the flange, and a rhomboidal rubber-ring packing *D* in the cylindrical joint beneath the lantern openings. When the flanges are bolted together, both rings are slightly compressed. Fig. 11 shows an arrangement of several packings to separate spaces in the same castings.

A joint similar in some respects to that shown in Fig. 3 is described by M. A. Pernolet in his book, "L'Air Comprimé," page 433, said to have been used during the construction of the Mount Cenis and St. Gothard tunnels. This joint is inferior to the Rapieff in several important details.

The Rapieff joint is not confined in its usefulness to high pressures. In a modified form it has been extensively used in the Philadelphia pneumatic postal tube system, where the air pressure seldom exceeds 5 pounds per square inch. This joint is shown in Fig. 12. A rectangular groove, ½ inch wide by ¼ inch deep, is turned in the face of one flange, and a tongue ⅜ inch wide by 5/32 inch high, is turned on the face of the opposite flange. The outside diameter of the tongue fits the outside diameter of the groove. A rubber ring, shown in Fig. 13, ½ inch wide by ⅛ inch thick, is laid in the groove and the two flanges are bolted face to face. The rubber ring is compressed between the face of the tongue and the bottom of the groove until it has a thickness of 3/32 inch, the surplus rubber flowing into a space provided by making the tongue narrower than the groove. The rubber rings are usually molded. The advantages of this joint over that of Fig. 3 are the alinement of the pipe sections by having a tongue and grooved joint, and the ease with which a rectangular groove and tongue can be machined accurately to dimensions.

B. C. Batcheller.

Experiments by the Danish government with windmills for electric power generation for industrial and agricultural purposes have demonstrated that those of the four-wing type are the most successful in operation because they give the most power for a given area. With a wind velocity of 20 feet per second—13½ miles per hour—one horse-power may be developed on 65 square feet of surface. With a velocity of 26 feet the power is doubled.

Bevel-gear Planing Attachment for the Shaper

This device is shown in Fig. 1, attached to a Cincinnati shaper and carrying a small miter gear with teeth just finished. Its construction is clearly represented in the general view and in the line drawing, Fig. 2.

The attachment is provided with a base plate which is rigidly secured to the table of the shaper and upon which is mounted a housing which may be rotated upon the base plate. Upon the housing is mounted on horizontal trunnions a head which can be swung in the vertical plane, and within which is fitted a spindle carrying an arbor on which the gear blank to be cut is clamped. The spindle is provided with worm wheel and worm, with an index plate fixed to the spindle frame and an indexing lever carried by the worm shaft, whereby the proper division of the gear blank is obtained for cutting any required number of teeth. The housing carries gear mechanism, all of which is plainly shown, for moving the spindle bearing in a vertical plane about its axis for cutting the proper depth of tooth, the feed through the bevel, worm, and spur gearing to the head being controlled either by hand or by power. The housing is provided with a quadrant, and the spindle frame with a vernier for obtaining readings to a fraction of a degree. The feeding movement for depth of tooth is limited by an adjustable stop which, in Fig. 2, is seen just to the left of the graduated quadrant. The feed mechanism for operating the head and spindle for depth of tooth also is adapted for rotating the housing to a given degree for cutting the proper contour of the tooth. This movement is accomplished by means of a vertical rack carrying a roller stud and a roller which is held in contact with a stationary templet having the proper curve

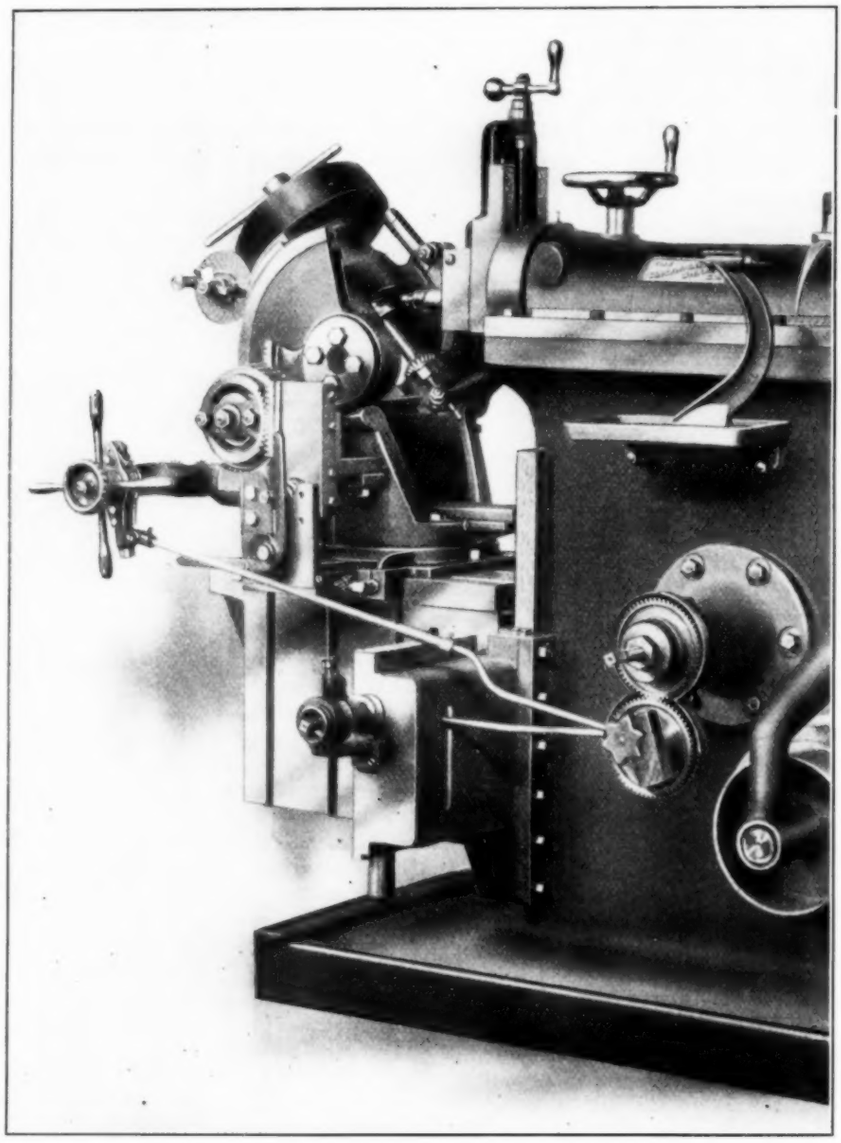


FIG. 1. BEVEL-GEAR PLANING ATTACHMENT ON THE SHAPER

formed on one edge. The rack, roll and templet are all clearly represented in the half-tone and line engraving. The templet is removable from its position to an opposite location, thus forming a guide for cutting the proper shape on both sides of the gear tooth. The bracket on which the templet is mounted is provided with a vernier as shown, for facilitating adjustment for cutting the correct thickness of tooth at the pitch line.

The gage shown in the side, rear and top views, Fig. 2, is to locate correctly the apex distance of the gear blank to be cut. It is fitted to slide in the housing in a plane at right angles to the horizontal pivot axis, and a gage arbor is carried as shown by the gage which is also applied in setting the cutting edge of the tool to the intersection of the axis or to the apex of the blank to be cut.

In the side view a gear blank is shown in dotted lines and the gage is shown as applied to it. In section *A B* is shown the draw-in rod, split collet, arbor and a gear blank mounted thereon. The means of adjustment for the apex distance of the gear blank will be understood from the sectional drawing. The two semi-circular gibs in the lower part of the housing secure a rigid connection of housing with base plate, as shown in the section and other views. An outer support for the arbor holds the gear blank to be cut, more rigidly.

The indexing worm can be disengaged by an eccentric knob, not shown in the drawing, and the spindle can be revolved for testing the arbor and gear blank for accuracy. A test bar can be inserted in the opening indicated in the side view for testing the accuracy of the gage.

The operation of the attachment is as follows:

(1) The gear blank is mounted on the arbor.

(2) The spindle head is adjusted for the pitch angle of the gear to be cut.

(3) The gear blank is adjusted for the apex distance by means of arbor nut and draw-in rod.

(4) The tool is adjusted to the apex by means of the gage arbor.

(5) The center of the former roller is adjusted to the pitch line marked on the former.

(6) The hand- or pilot-wheel is revolved in a direction to clear the work from the tool.

(7) The feed is connected and adjusted.

(8) The shaper stroke is adjusted.

(9) The index lever is adjusted for the correct number of teeth to be cut.

(10) The double lever is weighted down to press the roller against the former.

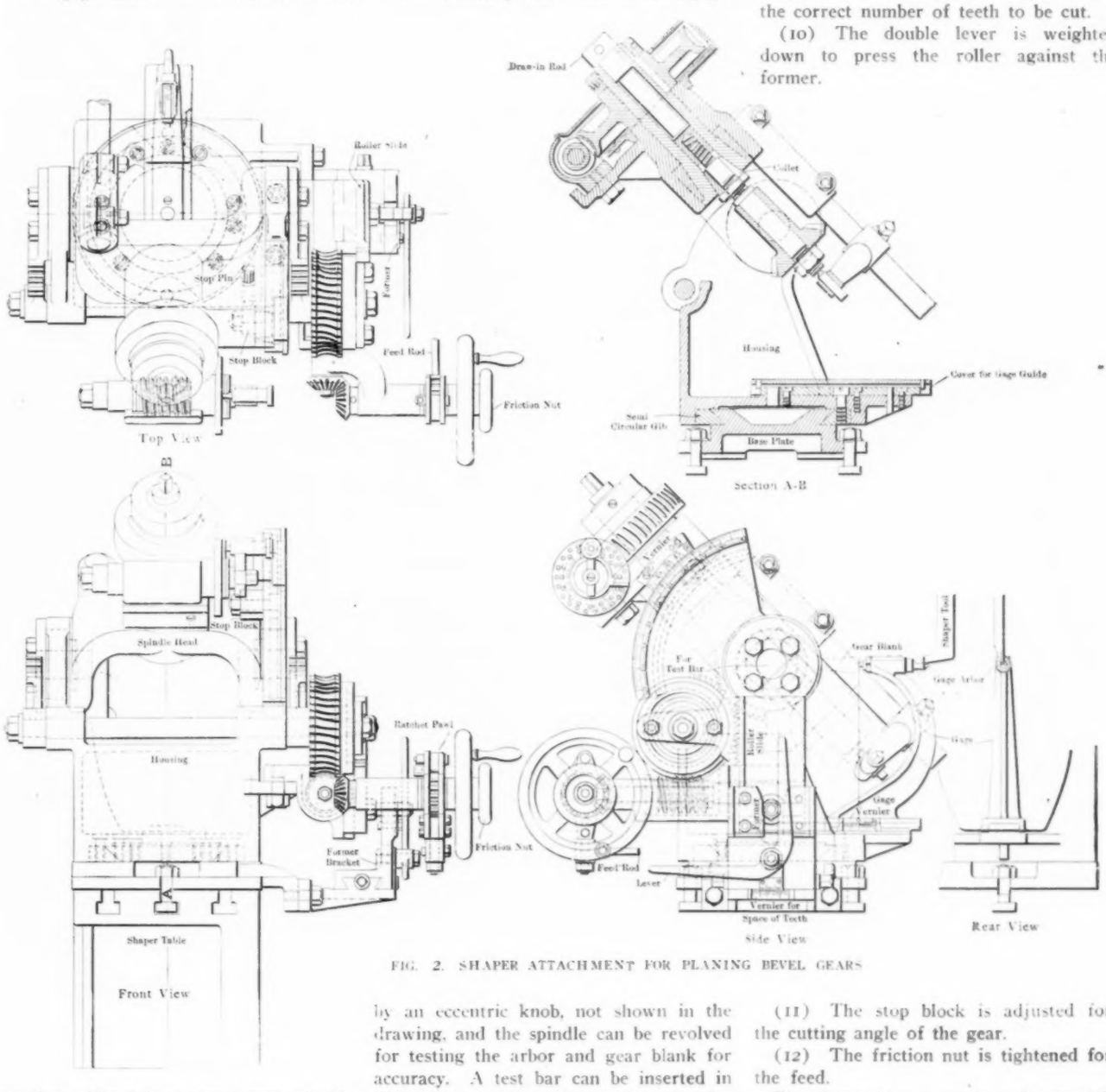


FIG. 2. SHAPER ATTACHMENT FOR PLANING BEVEL GEARS

(11) The stop block is adjusted for the cutting angle of the gear.

(12) The friction nut is tightened for the feed.

The shaper is now ready to be started. If the gear blank is not stocked out on the milling machine, a stocking cutter must be used first. For shaping the flanks of the teeth, side cutting tools are used. The work is fed into the tool until the stop-screw behind the graduated quadrant strikes against the stop block. This stops the feed automatically. The operator releases the friction nut and revolves the pilot wheel in a direction to clear the

blank from the tool for the next indexing. The same operation is repeated until one side of each of the teeth is cut. For the other side the tool is changed and adjusted as mentioned above. The former is reversed and adjusted for the thickness of the teeth. The double lever in front is operated for the other side, and the operations are repeated as before.

The spindle and spindle bearing are of tool steel, hardened, ground and lapped. The former or templet is also of tool steel hardened and ground. The attachment is the invention of Fred Mill, 704 Prytania avenue, Hamilton, Ohio.

Molding a Three-parted Job in a Two-part Flask

By W. W. McCarter

To make a three-parted job in a two-part flask is not altogether a new idea for

FIG. 1. PATTERN TO BE MOLDED

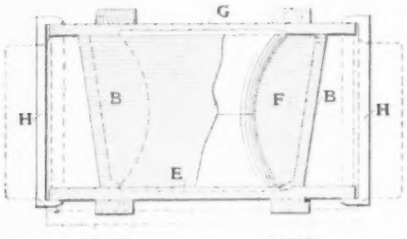


FIG. 2. INTERMEDIATE BOX CLAMPED TO BOTTOM BOARD

which any particular person may claim originality and there is a large amount of work which may be done in this way.

The job illustrated and described here may be made on a molding machine or in the ordinary flask, and various three-parted jobs may be made on the same principle regardless of their size or shape, as for example, a sheave wheel for an inch cable or a "cotton-head" casting whose opposite flange is of smaller diameter.

A sectional view through the center of the job herein described is shown by Fig. 1. The pattern is parted on the line *A A*. To mold this in the ordinary method would require a flask parted at the top and bottom of the pattern, between which would be located the cheek part of the flask.

If the job should be made on the machine in the ordinary way the flask would consist of two circular copes, one of which would be inverted to form the drag, and two circular intermediate sections known as the cheek. These would be joined together on the dotted line *C C*, Fig. 3.

To mold this job in a two-part flask two follow boards are used. One of these is

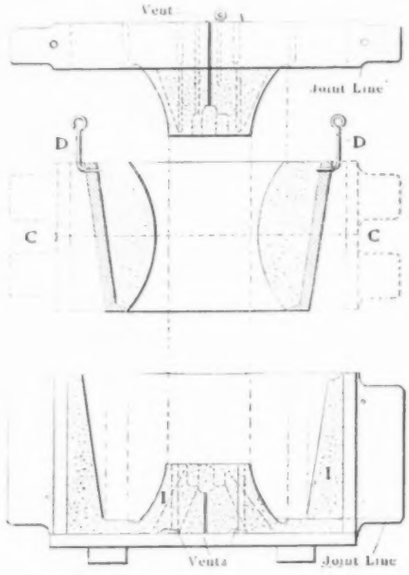


FIG. 3. THE MOLD READY TO ASSEMBLE

placed on the floor in a suitable location to permit of its being rolled over forward and backward. On this is placed the intermediate box *B*, Figs. 2 and 3. This box may be made square, hexagon, round or any shape desired and of wood or iron according to the number of castings required. It is located on the inside of the flask and lifts out with the hook *D* shown in Fig. 3. The depth of this box should correspond to the distance between the joint lines. The pattern is then placed inside the intermediate box *B* and upon the follow board *E* as shown in Fig. 2. The intermediate box is rammed up by first tucking facing sand against the pattern and filling up the rest of the space *F*; after this it is struck off flush with the top.

A follow board *G* similar to that upon which it is rammed is now placed and clamped as shown, after which it is rolled over. The clamps *H* and follow board *E* are then removed, parting sand is applied to the joint thus left and the drag *I*, Fig. 3, is put on, rammed up, vented, again clamped and rolled over to remain until poured. The clamps are then removed, follow board *G* taken off and the mold is ready to have the cope rammed up.

The arbor, as shown by Fig. 5, is now dipped in the clay-wash bath, and rapped to free it from excessive dripping, a little sand being also thrown upon it to aid this purpose. It is placed on the interior of the cope part of the pattern as shown by *J*, Fig. 4, and rests upon some facing sand which has previously been thrown loosely therein, to a depth of about a half inch. In placing the arbor in this manner, care should be taken that the two lifting screws *D D* are staggered to avoid coming in contact with the bars in the cope. Being thus placed the arbor is then tucked and the core thus formed is well pierced with the vent wire, after which the cope is put on, bars tucked, peened, butted, vented and the core again pierced with the wire. After this the arbor is wedged up to the cope as shown in Figs. 3 and 4. The cope part of the flask is lifted off and the cope half of the pattern drawn therefrom.

The intermediate box *B* is then lifted out and the pattern rapped at the time of lifting to leave that part of the pattern to be drawn from the drag. Thus, we see it is not at all necessary that the hub contained in either half of the pattern should be doweled on loose. The only division of the pattern that is at all necessary, is that which is shown by the line *A A*, Fig. 1.

In the dismembered mold, Fig. 3, the vertical dotted lines refer to the position

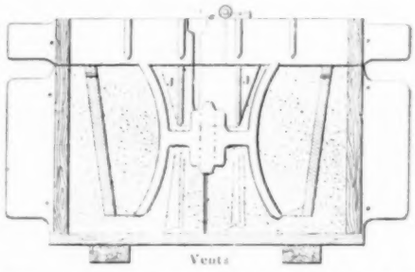


FIG. 4. ASSEMBLED MOLD SECTIONAL VIEW

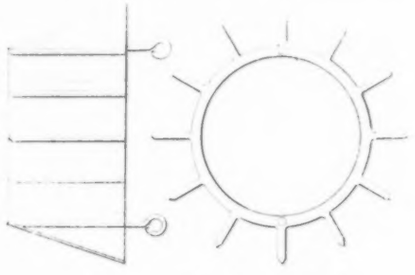


FIG. 5. ARBOR FOR COPE

of the parts and metal thickness provided when the mold is closed.

Rolling twice may give rise to a question of *not rolling* the intermediate section at all, but of bedding the pattern into it. This would involve the use of an odd side for the drag half of the pattern in order that its interior may be formed with celerity and would necessitate the rolling of that part of the pattern. Since this is the case, why not roll the entire pattern when the intermediate section serves the two-fold purpose of odd side, and cheek?

Detailed Instruction for Machine-shop Methods

A Planning Department Plans, Routes, Orders Material for and Controls All Production at the Mare Island Navy Yard

BY HOLDEN A. EVANS*

In a former article I have shown the general shop system in use in the construction and repair department of the Mare Island navy yard. This article will take up the detailed instructions for handling the work in the machine shop.

General Instructions Regarding Planning Department

The planning department, under the direction of the master machinist, will direct all work done in the machine shop. This department will receive its general instructions from the master machinist. All orders for work will go to the planning department, where orders will be separated into various classes, viz.: urgent orders, regular routine orders, manufacturing orders, plant-repair orders, etc. The planning department will lay out plans for the future course of such orders requesting plans from the drawing room, seeing that patterns are on hand, or if not, that they are ordered, ordering castings from the foundry and forgings from the shipsmith, and seeing that the necessary stock of material is on hand or ordered.

The planning department's instructions are supreme in designating the machine on which the work is to be performed and the route that the work shall follow, and no change will be made without the consent of the planning department. The gang bosses or speed bosses are invited to offer suggestions to the planning department if in their opinion the methods laid out can be improved, but under no circumstances is any change to be made unless such change is made by the planning department and shown on the route sheets or instruction cards as the case may be.

All castings, or forgings, or work requiring repairs must be deposited near the inspecting and laying-out table, and must be reported when delivered to the inspector. The inspector will inspect the work, and after receiving same, will report its arrival to the planning department. The inspector is, for the present, also the layer-out, and all work requiring laying out will, after the work is routed, be laid out on the laying-out table.

All special tools, or jigs, manufactured by the toolmaking department, after they have been tested and found satisfactory, will be reported to the planning department in order that they can be utilized on future work.

Any change in the design of work going through the shop, or quantity of work required, will be immediately reported to the planning department and the necessary orders given by that department. All work spoiled, or mistakes made, or damage to machinery or appliances, must be reported on the damage-report sheets to the planning department. This will be a notice to that department, after the approval of the naval constructor, to order new parts, or rectify mistakes, or repair damaged machinery or appliances, as the case may be.

In any case where the tools ordered for a job are not satisfactory, or the machine on which the job is to be done is not satisfactory, or the belts are not in first-class condition, or there are any other conditions which will interfere with carrying out the work, as laid out, expeditiously, or if any improvement can be made in the methods proposed, the mechanic discovering the same shall immediately report to the speed boss, or gang boss, whichever one is in charge of that part of the work, and the latter shall immediately bring this

ROTATION NO. 165. J. O. NO. 2133

WANTED FOR Coal Scuttle Center Bolts DR. NO. Dec 4 PATT. NO.

NO. WANTED 100 NO. DAMAGED 3 NAME OF PIECE Brass, round

ORDERED FROM Store House 11-9 1907 REC. 11-15 1907 ORDER ISSUED 11-21 1907 DR. FIN. 11-24 1907

MATERIAL Brass SIZE OF MATERIAL 2" round WEIGHT

OPERATIONS	MACH. #	ORDERED	MOVED	OPERATIONS ON DAMAGED WORK	MACH. #	ORDERED	MOVED
1ST Forge	Drop forge	✓	✓	1ST Forge 3	Drop forge	✓	✓
2ND Turn face + chase thread	T1-1	✓	✓	2ND Turn face + chase thread	T1-1	✓	✓
3RD Mill Slot in head	M M4	✓	✓	3RD Mill Slot in head	M M4	✓	✓
4TH Drill ends cut + pt pins	D 7A	✓	✓	4TH Drill ends cut + pt pins	D 7A	✓	✓
5TH Inspect in rec'd. store		✓	✓	5TH Inspect in rec'd. store		✓	✓
6TH				6TH			

FIG. 2. SPECIMEN ROUTE SHEET

Shop Order Stub No. 26

C. & R.

JOB ORDER No. 2133

Master Pattern Maker

	Month	Day	Hour	Initials
1 - Issued	12	20	8	R.H.S.
2 - First Process	12	22	-	G.F.B.
3 - Forwarded to Machine	12	20	330	
4 - Second Process	12	27	-	H.S.S.
5 - Returned	12	20	4	
6 - Received	12	20	430	R.H.S.
7 - Ent'd Complete	12	22	3	G.F.B.
8 - Ret'd Complete	12	27	2	H.S.S.
9 - Checked	"	"	"	R.H.S.

Remarks 12-24" Coal Scuttle Wood deck

Master Machinist

Shop Order No. 26

CONSTRUCTION & REPAIR

NAVY YARD, MARE ISLAND.

JOB ORDER No. 2133 (Date) 12-20-07

Title A Appropriation Plan No 9 ¢

Master Pattern Maker

Please do the following work: Furnish patterns and Castings for 12-24" Scuttle Rings and Covers Wood deck

as per plan 9 ¢

Work desired completed by Dec 27 07

Respectfully,

Qtrm. Machinist

FIG. 1. SPECIMEN JOB ORDER

*Naval Constructor, United States Navy, Mare Island Navy Yard, California.

matter to the attention of the planning department for correction. For work for which new patterns are made, where a number of pieces are to be cast from the pattern, one piece will first be cast and machined to completion and carefully inspected for the purpose of determining whether or not proper amount of stock has been allowed for satisfactory finish, and particularly where too much stock has been left, as this is the usual fault. *Carefull attention is to be given to this matter and all unnecessary finishes are to be eliminated.*

After this inspection has been made the planning department will notify the patternmaker of the changes desired in the pattern, or if none are desired, will notify the patternmaker to this effect, and request him to order the remaining castings. When in any castings too little finish, or unnecessary finish, is discovered by the layer-out, gang boss or speed boss, the matter will be immediately reported to the planning department and the necessary steps taken by that department to remedy the fault.

The planning department will control all drawings issued from the drawing office to the machinist department, and will issue the same to workmen upon checks as required. Any errors discovered in drawings, or improvements suggested, should be reported by the mechanic, outside quarterman, or leadingman, gang boss, or speed boss, to the planning department, and that department will make the necessary report, through the master machinist, to the main office in accordance with instructions regarding corrections to drawings.

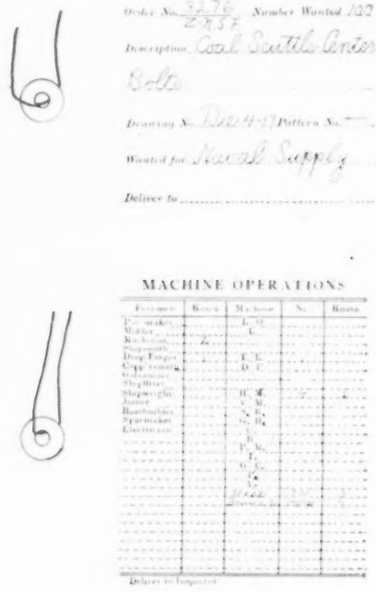


FIG. 3. SPECIMEN ROUTE TAG

The planning department will control and issue all shop orders in accordance with instructions regarding shop orders, store requisitions for material in store, and stub requisitions for material not in store. It will see that on shop orders the proper dates are given on which it is desired the work shall be completed. On shop orders received from other foremen which require promises, the planning department will make on the proper stubs the necessary promises. All promises made by other departments as to time of completion of work, either on a shop-order stub, or on the request-for-promise slip, will be handled in this department, and in case of other departments not keeping their promises, it will be the duty of the planning department to call attention to the expiration of the allotted time and, in case of necessity, notify the naval constructor regarding the delay.

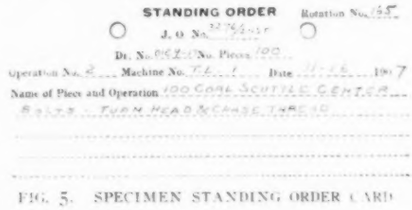

STANDING ORDER
Rotation No. 65
J. O No. 3276/2N&F
Dr. No. Dec 4-17 No. Pieces 100
Operation No. 2 Machine No. T.L. 1 Date 11-15 1907
Name of Piece and Operation 100 COAL SCUTTLE CENTERS
Bolts - Turn Head & Chase Thread

FIG. 5. SPECIMEN STANDING ORDER CARD

There will be issued from the planning department, after approval by the master machinist, detailed written instruction of the duties of the tool-room keepers movemen, tool-delivery boys, sweepers, cranemen, and others who have general duties of this kind to perform. In each case these instructions must specify in detail the work to be done, and, as far as possible, prescribe a *daily task for each man.*

Planning Department and Machine-shop Staff

Planner—The planner will be in charge of the department. It will be his duty to personally study all orders received and familiarize himself with the requirements of each job; oversee the making of all shop orders; study the drawings for each job, and note on the instruction cards any special points in connection with the work; plan and route through the shops in proper order all work, and see that there is no delay at any point; see that the instruction cards are followed, and that speed bosses and gang bosses properly instruct the workmen; see that high-paid men are not put on low-class work. In other words, the planning department is to be the "clearing house" of the shop, and, as its name implies, is to plan all work before it is undertaken and see that its plans and instructions are carried out. The planning department has a right to expect, and must demand, the hearty coöperation of the speed bosses, gang bosses, inspector, repair man, head toolmaker, etc., and if this is not obtained, the management of the shop will be a failure. Any failure in carrying out instructions, or lack of coöperation must be immediately reported to the master machinist and reported by him to the naval constructor.

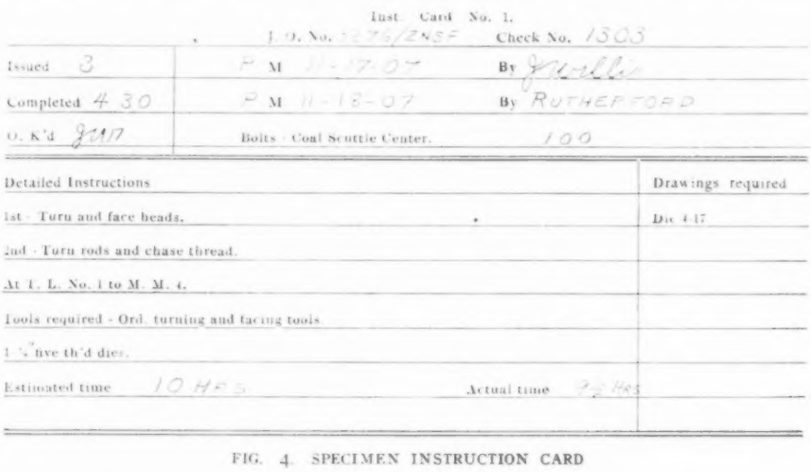

Inst. Card No. 1.
J. O. No. 3276/2N&F Check No. 1303
Issued 3 P M 11-17-07 By
Completed 4 30 P M 11-18-07 By RUTHERFORD
O. K'd
Bolts - Coal Scuttle Center. 100
Detailed Instructions
Drawings required
1st - Turn and face heads. Dec 4-17
2nd - Turn rods and chase thread.
At T. L. No. 1 to M. M. 4.
Tools required - Ord. turning and facing tools.
1 ¼" hve th'd dies.
Estimated time 10 HRS. Actual time 9½ HRS

FIG. 4. SPECIMEN INSTRUCTION CARD

The planner will have the assistance of a time-study man (draftsman), his assistant (helper), a clerk and a boy. The time-study man will, under the direction of the planner, make all necessary time studies, and shall record all data taken in such form that it can readily be used in making estimates. Minute time studies will be made of all duplication work. The planner will also arrange to have a special study made of the first of a duplication job to the end that the best methods may be followed on the succeeding jobs. Instruction cards will be prepared and filed away for all duplication work and will be issued for succeeding jobs. It will be the aim of the gang and speed bosses to reduce the times previously made until the actual minimum is reached.

Time-study man—The time-study man will, under the direction of the planner, and with his assistance, make an estimate of the time required for each job at each machine or bench. This "estimated time" will be entered on each instruction card. When the job is completed the "actual time" will also be entered on the instruction card. The "actual times" and "estimated times" will be recorded under the job and also under the machine, and will be so indexed that the data can be readily found when wanted for the same work repeated, or similar work.

Gang boss—The gang boss has charge

of the preparation of all work up to the time that the piece is set in the machine. It is his duty to see that every man has at all times at least one piece of work at his machine, with all the jigs, templets, drawings, driving mechanism, sling chains, tools, etc., ready to go into his machine as soon as the piece he is actually working on is done. The gang boss must show his men how to set their work in their machines in the quickest time and see that they do it. He is responsible for the work being accurately and quickly set, and should be not only able but willing to pitch in himself, and show the men how to set the work in record time. After this is done he will turn the machine and workman over to the speed boss, who can refuse to accept the job if he is not satisfied with the conditions; if the job is accepted by the speed boss, he is wholly responsible for future results. As soon as the machining is completed, the job reverts to the gang boss, who is responsible for taking the work out of the machine and for moving work from one place to another, according to routing instructions. The gang boss is responsible for order and the observance of shop rules. He is responsible for the general condition and temperature of the shops and the cleanliness of wash rooms, toilet rooms and clothes lockers.

Speed boss—The speed boss must see that the proper cutting tools are used for each piece of work; that the work is properly driven; that the cuts are started in the right parts of the piece, and that the best speeds and feeds and depth of cut are used. This work begins only after the piece is in the machine and ends when the actual machining ends. The speed boss must not only advise his men how to best do this work, but he must see that they do it in the quickest time, and that they use the speeds and feeds and depth of cut as directed on the standard sheets. In many cases he is called upon to demonstrate that the work can be done in the specified time by doing it himself in the presence of his men. He is also responsible for floor work and vise work after the gang boss has provided tools, drawings, rigs, etc., for this in the same manner as described for machine work. He is solely responsible for the quality and quantity of work turned out. He will properly instruct the workman wherever such instruction is necessary. He will inspect the first piece of each lot completed, and if correct, will mark the piece for identification and return it to the workman as a sample by which to finish the remainder of the lot. If the job is on but one piece and of considerable detail, each operation will be directed and inspected. The speed boss will be the inspector of all machine work and floor and vise work.

Lay-out man and receiving inspector—He will receive all work sent in the shop, whether forgings, castings, or repair jobs, will carefully inspect the work and report in writing to the planning department the receipt of the work and the result of the inspection. He will lay out all castings and forgings to drawings, samples or instructions when routed to him. The lay-out man will be under the supervision of the gang boss.

Movеman—He will count the castings, forgings, etc., received in the machine shop and will report to the receiving inspector the result of the count.

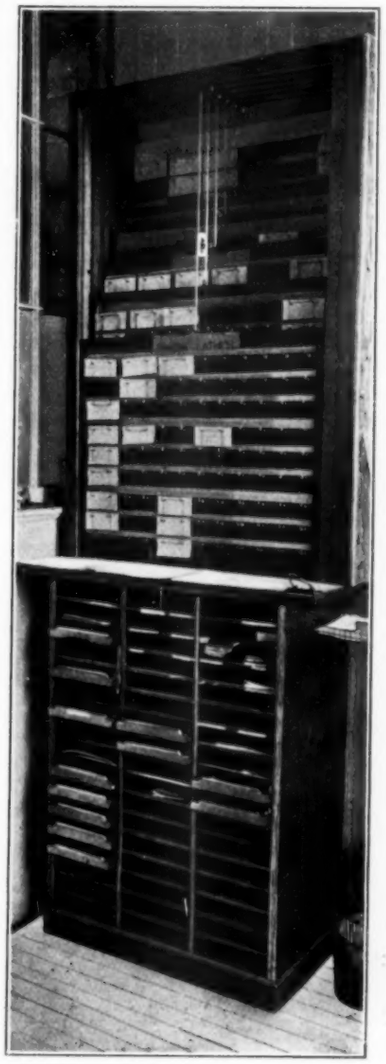


FIG. 6. BOARDS AND STANDING-ORDER SLIPS

He will place the "route tag" on each job and see that it moves with the job. He will move the work from one machine to another, or from one place to another, in accordance with instruction cards placed on the "move hook." He will keep the benches in order and free from rubbish.

Head toolmaker—The head toolmaker will be depended upon to provide the machine tools with the best tools, jigs and appliances. It will be his duty, in coöperation with the planning department, to make a special study of all duplication work so as to provide such special tools and jigs as the work will warrant. Such special tools and jigs must be entered on the instruction cards. He will be in charge of the tool rooms and all machine tools in the shops, and it will be his duty to see that all machines and tools are kept in the highest state of efficiency. He will have as assistants, in addition to the regular tool-room force, a repairman and beltman, whose duties under the head toolmaker are as follows:

Repairman—It is his duty to see that each workman keeps his machine clean, free from rust, and that he oils and treats it properly. He will see that a damage report is submitted for any damage to a machine other than fair wear and tear, in accordance with the instructions for making damage reports. He will see that all standards established for the care and maintenance of the machines and their accessories are rigidly maintained, such as the care of belts and shifters, cleanliness of machines and floor around machines, and order of tool lockers. He will see that the tool lists on lockers at machines are kept up to date, and that such lists are accurate inventories of the tools and appliances supplied the machines. When a key of a locker is turned in, owing to a workman being shifted from the machine, he will inspect and check up the tools and appliances belonging to the machine. He will also make all ordinary repairs to machine tools.

Beltman—The beltman will be responsible for the care of belts in the machine shop, smith shop, and foundry, and will follow the instructions issued regarding care of belting. He will oil all main shafting and counter-shafting.

Delivery of tools to machines—It will be the duty of the gang boss to see that every machine is supplied in advance with proper tools. A half day's supply of standard tools will be issued. When it is necessary to make special lathe or planer tools for jobs, the gang boss will have two of each kind made, so that while one tool is in the machine, the other can be reground. After the machine is started, the speed boss is responsible for the tools. The tool-delivery boy will make trips around the shop every 15 minutes to get completed work-instruction cards and dulled tools. The tools he will take to the tool room for exchange for sharp tools. The complete work-instruction cards he will turn into the planning department. The speed boss is responsible that the tools are kept in good condition and that no workman has to wait for a tool. If at any time a workman has not on hand a tool to duplicate the one he has in the machine, he will immediately report it to the speed boss, who will see that he is supplied. The speed boss is responsible for any delays due to lack of *sharp tools*; the gang boss for any delays due to lack of *proper tools*.

Method of Operating System

Job orders for all work are issued from

the main office and must be signed by the naval constructor. A specimen is shown by Fig. 1. These orders are receipted for by the master machinist or, in his absence, by his clerk, in which case the job order must be given to the master as soon as he returns to the office. The master will make himself familiar with the order and will initial it and forward to the planning department where it will come under the immediate attention of the planner. If the order is marked "URGENT," it must be given right of way over all ordinary orders, and must receive the immediate attention of the planner and staff. The planner will study the requirements of each order and will then make out the "route sheet" in duplicate (see Fig. 2), planning the job from beginning to delivery. He will see that the necessary drawings are on hand for the job, and if not, he will call on the drawing office for the same. He will make out the route tags, and if both forgings and castings are required, two tags will be made. A specimen tag is shown by Fig. 3. The shop orders will be made out giving all necessary information, particularly the time required, and this must be *definite* and not "*as soon as possible*," which means nothing. The order on the patternmaker for castings will be accompanied by a route tag which will go with the casting tag to the foundry and be attached to the castings and returned to the machine shop with them. The same procedure will be followed for forgings. The instruction

TIME CARD

Date 11-17-07 Check No. 1516

Job No.	OPERATION	Hours	Days
3642	3½" Std. Cast Iron Flanges		
3216	Coal Scuttle Center Collar		

NOT FINISHED

FIG. 8. SPECIMEN TIME CARD

cards will be made up for each machine, or vise, or floor work. Every instruction card will bear on its face the "estimated time" to complete (see Fig. 4). The standing order tag will also be filled out (see Fig. 5). All data except shop-order and route tags will now be filed in the envelop on one copy of the route sheet, and the data on which machine work should commence to enable the job to be completed, should be marked in a conspicuous place on the envelop. The copy of the route sheet with the envelop will be filed and indexed under "subject heads"; that is, name of ship, naval supply manufacture order, plant repair job, special deposit order, etc., so that it can readily be found. The other copy of the "route sheet" with the date the materials should be in the machine shop, conspicuously marked on it, should be filed by *dates* shown on sheet and serves as a "tickler," so that if forgings, castings and material ordered are not reported in the shop by the date required, the necessary steps can be taken to expedite these.

When ordering castings, etc., the schedule of material required for the job must also be made up and store orders made for that in store, and stubs put in on the requisition office for such material as will have to be purchased, specifying *definitely* the date on which the material is required.

When the castings, forgings, etc., are reported in the shop and inspected, the route sheet will be opened up, the standing orders placed on the board and the instruction cards issued to the machines.

In the planning room are the "shop boards." These consist of a number of

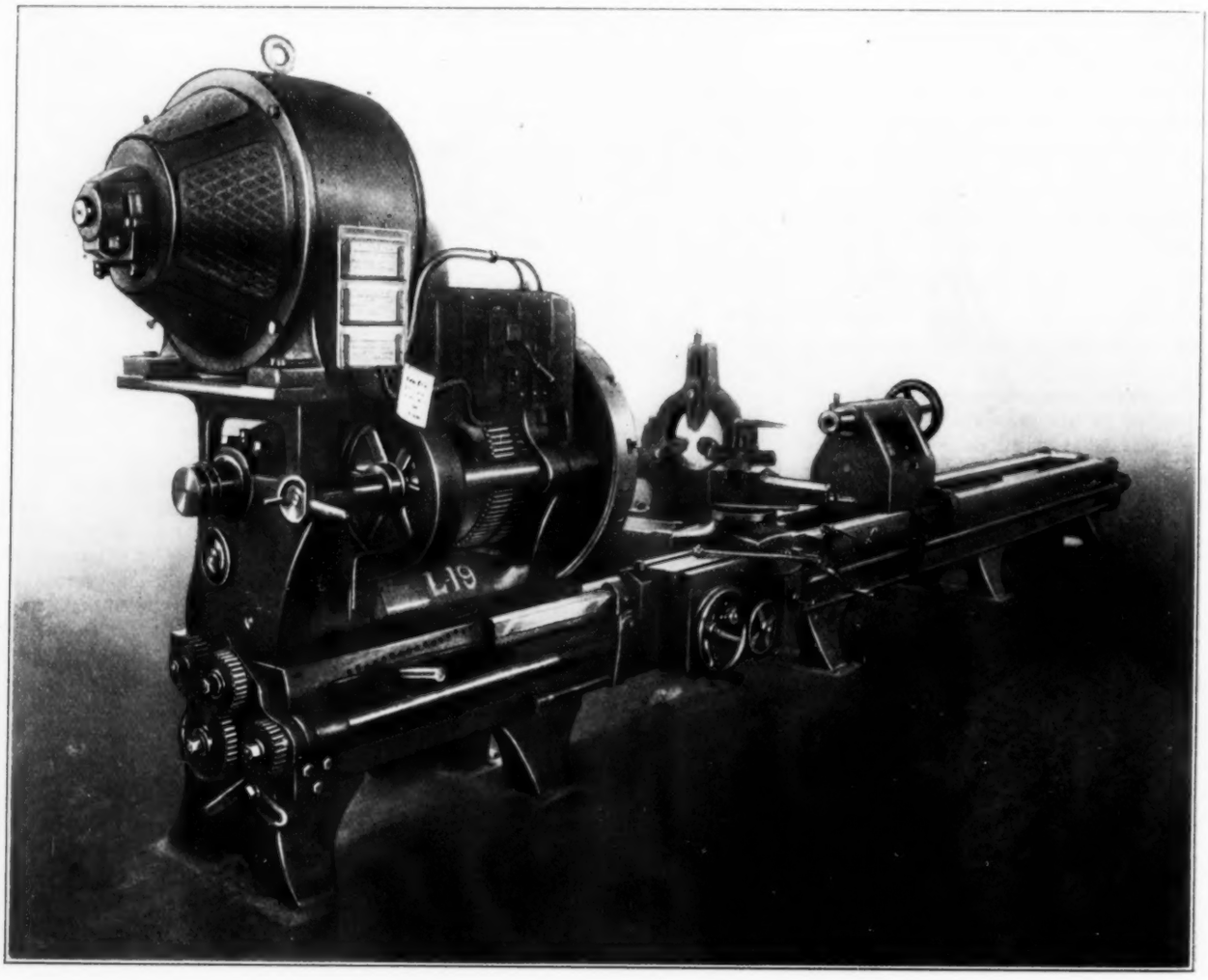


FIG. 7. MOTOR-DRIVEN LATHE SHOWING HOLDERS FOR CARDS AND HOOK FOR COMPLETED CARD

boards about 3 feet square mounted in a cluster in a frame and, like a window sash, provided with sash cord and balancing weights. The "down" position of the board brings the lower edge of the board about 36 inches above the floor, this being a convenient working hight. When a board is not in use it can be raised out of the way, exposing the next board in the rear. On these boards there is marked the number of every machine and vise in the shop. These are conveniently grouped; the turret lathes being grouped on one board, the shapers on another, planers on another, large engine lathes on another, small engine lathes another, milling machines another, vises another, etc. Under the number of each machine or vise there are three small spaces, the size of the standing-order slips, each provided with the hooks on which the standing-order slips are hung. The slip hanging on the upper hook, or No. 1, shows that job to be *actually* in the machine; the slip on the next lower hook, or No. 2, shows that job *at* the machine, provided with tools, drawings, and all necessary information, and is to go in the machine immediately when No. 1 job is finished. The slips on the lowest hooks, or No. 3, are the jobs *in the shop*, but not necessarily at the machine for which the gang boss is providing the necessary tools, drawings, etc. There will often be a number of slips on No. 3 hooks; the slip on top is the one that is to go to the second hook, and for which tools, etc., should be provided; the rotation numbers on the slips indicate the order in which the work will be taken up.

In the case underneath the boards are filed the instruction sheets.

It is by means of the boards that the planner can keep track of the work as it goes through the shop. The half-tone illustration, Fig. 6, shows clearly the boards and the standing-order slips.

At each machine there is a holder which has three pockets for instruction cards. These cards represent the same jobs as the standing orders for that machine on the board in the planner's room. The card in the upper pocket represents the work in the machine. The card in the middle pocket represents jobs at the machine for which tools, jigs, drawings, etc., are assembled. The cards in the lower pocket represent jobs in the shop, but not necessarily at the machine, for which tools, jigs, drawings, etc., are being collected.

Upon the completion of the job represented by the card in the top pocket, the workman will remove the card, note the time of completion on its face, and hang it on the hook for completed work, and will shift the other two cards up. The holders for the cards and also the hook for the completed cards are shown in the half-tone illustration of a motor-driven lathe, Fig. 7. The toolboy will collect the completed instruction cards and take them to the planning department. Here the standing order for this job will be removed from the board and the instruction card will be put on the "move hook," where it will be found by the moveman on his rounds, and serves as an order to him to make the move to the machine designated on the card. After the work has been moved, the moveman will initial the card and return it to the planning department, this serving as a notice to this department that the work is at the next machine. This method will be continued from machine to machine until the work is inspected and ready for delivery either to the storehouse or to the outside machinists for installation.

Other forms used are shown by Figs. 8, 9 and 10, a time card, shop-observation card and shop-record card, respectively. The shop-observation card is used for stop-watch time studies.

JOB ORDER 276 ZNSF **SHOP OBSERVATION CARD** No 175 DATE 11-17-07

CHARACTER OF WORK CENTER BOLTS FOR COAL SCUTTLES { DROP FORGED / NAVAL BRASS / ROUND }

WORKMAN RUTHERFORD 328 RATE

STARTED TO SET MAC 3 P.M. 11-17-07

MACHINE ALL SET AT 3.30 "

BEGAN WORK " " "

COMPLETED WORK 2.30 PM 11-18-07

REMARKS LOT OF 100

ESP TIME 10 HRS

OPERATION	DESCRIPTION OF OPERATIONS	1	2	3	4	5
A	PLACE IN MACHINE	24	1.46	3.50	4.55	6.21
B	TURN & FACE HEAD	1.25	2.50	4.16	5.58	7.16
C	LAND ON FLOOR	1.30	2.51	4.26	6.06	7.20
D						
E	PLACE IN MACHINE	16	1.58	4.27	6.17	8.00
F	CHAMFER END	20	2.05	4.32	6.18	8.08
G	TURN SHOULDER FOR THREAD	46	3.05	5.11	6.57	8.45
H	THREAD	1.24	3.49	5.45	7.35	9.08
I	LAND ON FLOOR	1.30	3.52	5.53	7.42	9.15
J						
K						
L						
M						

FIG. 9. SPECIMEN SHOP OBSERVATION CARD

JOB ORDER 397 ZNSF **SHOP RECORD CARD** DATE 11-17-07

CHARACTER OF WORK CENTER BOLTS FOR COAL SCUTTLES

WORKMEN	Pay No.	OPERATION	No. of Pieces	Actual Time Lost	Actual Time Lost	No. P. per Hr.	Std. No. of Pieces per Hr.	Quantity Completed	Actual Time Required	Per Cent of Time Lost	Cost of Work Time Lost	Cost of Work Time Required	Number of Operations
WILSEY AND ROY	249	DROP FORGER	100	—	1 HR 12 MIN 7 SEC	—	5	93	1 HR 7 MIN 24 SEC		11 CENTS	90 CENTS	
RUTHERFORD	413	TURN & FACE CHASE INSIDE	100	1 HR 1 MIN 30 SEC		5	20	11	5 HRS 30 MIN	20	90 CENTS	4.90	175
HOGER	314	MILL INSIDE OF HEAD	100	MINUTES		5	24	12	4½ HRS	100	1.35	2.64	190
JOHNSON	369	DRILL & TAP SQUARE HOLE	100	1 HR 14 MIN		6	15	9	6⅔ HRS	11	65	3.46	184

FIG. 10. SPECIMEN SHOP RECORD CARD

Straightening Hardened Tools

T. Foor

It is not always that one can harden tools and keep them straight, so any kinks in the hardening process may be of benefit to the readers of the AMERICAN MACHINIST. It is also well to know how to straighten them without going to the trouble of annealing and rehardening the piece. If the reasons for steel getting out of shape in hardening are known then in nine cases out of ten it can be avoided, but that other tenth chance still remains.

I have had a great many shear blades, forging die plates and reamers to harden and temper in my line of work and very early discovered, that where the piece was not thoroughly annealed, this was one cause of distortion in hardening; the next and most common cause was the irregularity of heat at the time of dipping, as it is seldom it will warp if the heat is perfectly uniform throughout. In the case of annealing get a perfectly even bright red heat and bury deep, then give plenty of time to cool. The same may be said of the quenching although the nature of the steel will have to be taken into consideration.

When I know I have observed all the necessary precautions as to annealing and heating and the piece still kinks, after drawing the temper and while the piece is hot I place it on an oak block, slightly concaved in the middle, then with a hickory mallet, made specially for this purpose, held on the high spot one or two smart taps with the sledge will generally bring it true; of course good judgment must be exercised and not too strong a blow used.

I have straightened a great many shear blades this way, some 1¼x5x14 inches and never broke one or failed in straightening them. I made a saw for a milling machine not long ago which had to be hardened; this I clamped between wrought-iron plates with a bolt through the arbor hole, then heated and dipped it all together and it came out perfectly straight. Butcher knives seldom come out of the water straight, but the oak block and hickory mallet straightening appliance will soon bring them to the shape they should be.

Sulphur is one of the best things for a hot bearing, and is often used at sea on engine guides and crank pins. It is best used in a powdered form mixed with oil.

Measuring Dovetail Slides, Gibs and V's*

Application of Wires of Known Diameters in the Accurate Measurement of Male and Female Dovetails and V's of Various Angles

BY FRANK H. SCHEU

At page 873, Vol. 30, Part 2, an article appeared on "Measuring Dovetails," by Walter Cantelo. It is an interesting and important subject, and for this reason an article covering wider applications of this principle of measuring may be welcomed by many machinists and toolmakers.

The article referred to gives a formula for finding the maximum diameter of wire, that may be used to measure the dovetail, by the method illustrated in Fig. 1. This means that the point of contact with the wire of maximum diameter is on the very upper edge of the dovetail. This condition is not desirable. The line of contact should be kept a little lower, as shown in Fig. 1. Many dovetails have clearance on top and a couple of thousandths less in hight would not make any difference in the fitting of the slide, but would throw out the measurement of the dovetail. The size of wire obtained by the formula given will be an odd one and will have to be made specially. If not made special, the next smaller standard size has to be taken. For this reason the figuring of the size of wire seems to be wasted time. It can be very readily seen from the drawing or with a wire against the working piece, if the wire is the required size.

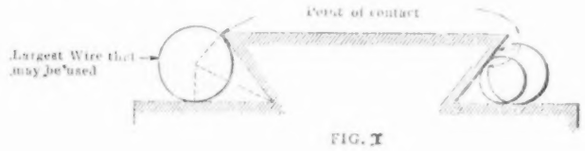


FIG. 1

FIG. 2

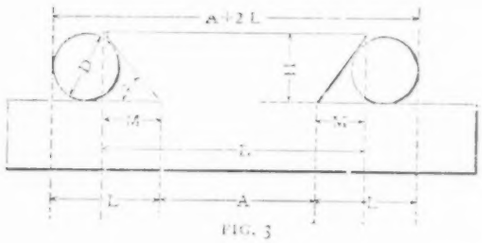


FIG. 3

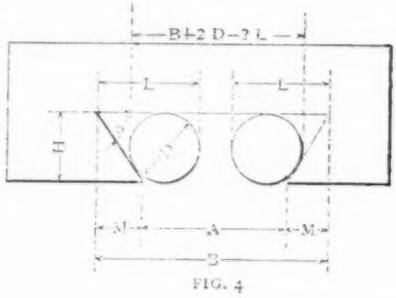


FIG. 4

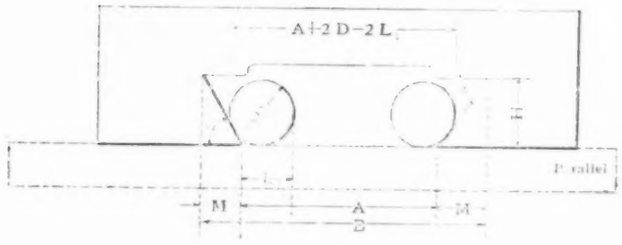


FIG. 5

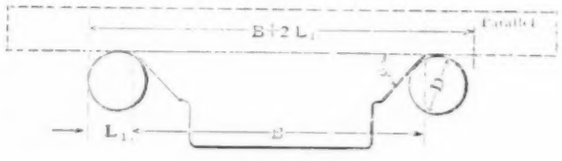


FIG. 6

MEASURING DOVETAILS

Gaging Female Dovetails

In the article referred to the female dovetail is gaged by measuring between the wires, as at *A*, Fig. 2. The more common practice is to measure the outside of the wires, as at *B*. The wires have to project a little at the end of the slide and a micrometer reading can be taken easily. In most cases the male part will be planed first and the female part fitted to it, or if a large number have to be planed, gages will be made on the same principle.

To simplify the matter of measuring dovetails several tables for practical limits have been worked out and are given here. On the smaller sizes of dovetails the diameter of the wire increases by 1/16 and 1/8 inch, on the larger ones by 1/4 and 1/2 inch.

Ordinary Forms of Dovetails

Considering dovetails of the shape shown in Figs. 3 and 4, on the drawing the draftsman will give either dimension *A* or *B* for the width of the dovetail, sometimes both. To find either dimension *A* or *B* if the other is given, figure out *M* according to the formula:

$$M = \frac{H}{tan.\ \alpha}.$$

If angle $\alpha = 45°$ distance $M = H$.

If angle $\alpha = 50°$ distance $M = \frac{H}{1.19175}$.

If angle $\alpha = 55°$ distance $M = \frac{H}{1.42815}$.

If angle $\alpha = 60°$ distance $M = \frac{H}{1.73205}$.

To find L the formula $L = \frac{\frac{D}{2}}{tan.\ \frac{\alpha}{2}} + \frac{D}{2}$ has to be used.

Table 1 has been figured this way and applies to the dovetails shown in Figs. 3 and 4.

The Use of Parallels

On several dovetails the top of the female slide is either rough planed or not machined at all. In this case the measurement has to be taken from the bottom part. A parallel has to be clamped across the bottom and the reading taken as illustrated in Fig. 5. This is the more correct way of measuring the female dovetail.

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if clearance is given on top; only it is a little inconvenient and cumbersome. To find L_1 the formula

$$L_1 = \frac{\frac{D}{2}}{tan.\left(90^\circ - \frac{\alpha}{2}\right)} + \frac{D}{2}$$

has been used and Table 2 developed this way. Table 2 also will be of use for dovetails as illustrated in Fig. 6.

APPLICATION TO DOVETAIL GIBS

Figs. 7 and 8 illustrate the measuring of a dovetail gib. In Fig. 7 the top is the important surface and the measurement should be taken in relation to that surface.

Dimension L is required and given under Table 1. If for some special reason it is preferred to work from the bottom, as shown in Fig. 8, Table 2 will give the required dimension L_1.

Fig. 9 illustrates a gage for the gib shown in Fig. 7. The required measurement in this case is K, which can be easily obtained. Use Table 2, which gives the value for L_1. Subtract this from A and the remainder is K. Another form of dovetail, used by machine-tool builders, is illustrated in Figs. 10 and 11. Fig. 10 represents the male and Fig. 11 the female slide. For Fig. 10, Table 1 has to be used, and for Fig. 11, Table 2.

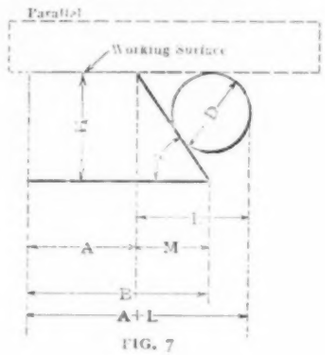


FIG. 7

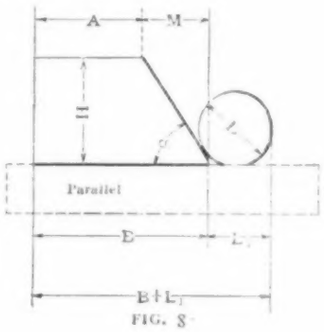


FIG. 8

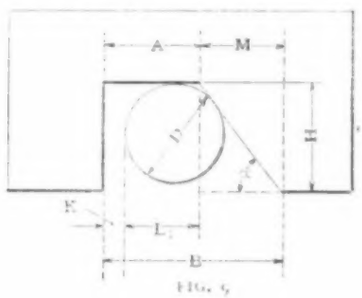


FIG. 9

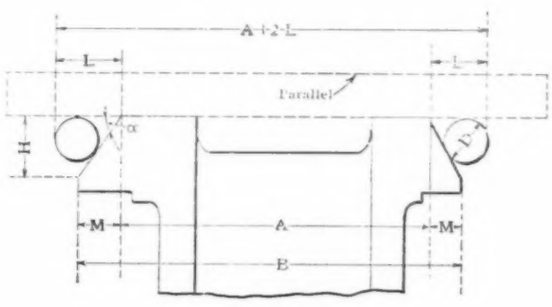


FIG. 10

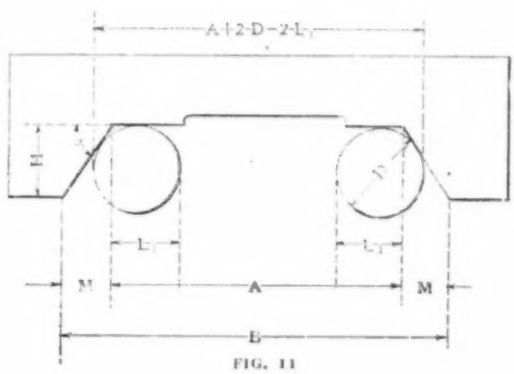


FIG. 11

MEASURING DOVETAILS

For Dimension L											
	D=1/4	D=5/16	D=3/8	D=7/16	D=1/2	D=5/8	D=3/4	D=7/8	D=1	D=1 1/4	D=1 1/2
α = 45°	.4268	.5335	.6402	.7469	.8536	1.0670	1.2804	1.4938	1.7071	2.1339	2.5607
α = 50°	.3931	.4913	.5896	.6879	.7861	.9827	1.1792	1.3757	1.5723	1.9653	2.3584
α = 55°	.3651	.4564	.5477	.6390	.7303	.9128	1.0954	1.2779	1.4605	1.8256	2.1907
α = 60°	.3415	.4269	.5123	.5976	.6830	.8538	1.0245	1.1953	1.3660	1.7075	2.0490

Table 1 - Values of L (Figs. 3, 4, 7, 10 and 12.)

For Dimension L_1											
	D=1/4	D=5/16	D=3/8	D=7/16	D=1/2	D=5/8	D=3/4	D=7/8	D=1	D=1 1/4	D=1 1/2
α = 45°	.1768	.2210	.2652	.3094	.3536	.4419	.5303	.6187	.7071	.8839	1.0607
α = 50°	.1833	.2291	.2749	.3208	.3666	.4582	.5499	.6415	.7332	.9164	1.0997
α = 55°	.1901	.2376	.2851	.3326	.3801	.4752	.5702	.6653	.7603	.9504	1.1404
α = 60°	.1972	.2465	.2958	.3450	.3943	.4929	.5915	.6901	.7887	.9858	1.1830

Table 2. - Values of L_1 (Figs. 5, 6, 8, 9, 11 and 17.)

VALUES OF L AND L_1 FOR DOVETAILS AND V'S OF VARIOUS ANGLES WHERE D = DIAMETER OF WIRE

The rest will be understood from the illustrations.

Machine Tool V's

Last of all is to be considered the shape of the V, as illustrated in Figs. 12 and 13, used on lathes, planers, grinders and many other machine tools. It is advisable to plane the female part, Fig. 13, first and fit the male part, Fig. 12, to it. The female part can be easily measured as shown later on the gage; but this operation on the male part is more difficult. A parallel has to be clamped on top of the V, as shown in Fig. 12, and dimensions $A+B+2L$ or $A+2L$ can be measured. A and B have to be given on the drawing, and for dimension L see Table 1. In manufacturing V's three gages will be needed, a roughing, a male and a female gage as illustrated in Figs. 14 to 17, respectively.

The Gages Required

The roughing gage, Fig. 14, will be used

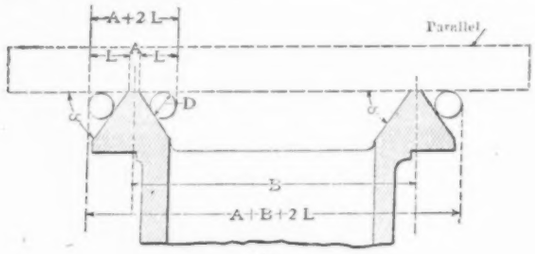


FIG. 12

FIG. 13

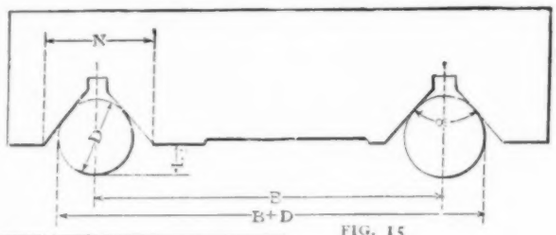


FIG. 15

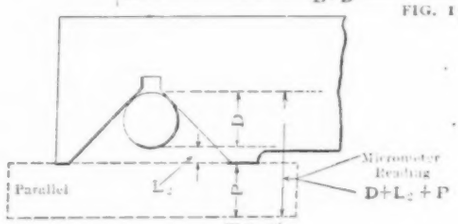


FIG. 16

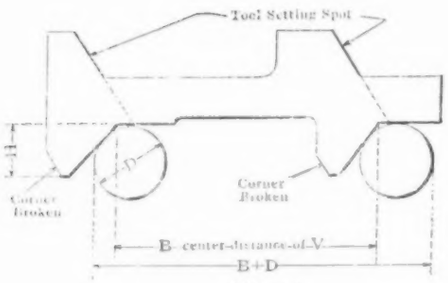


FIG. 14

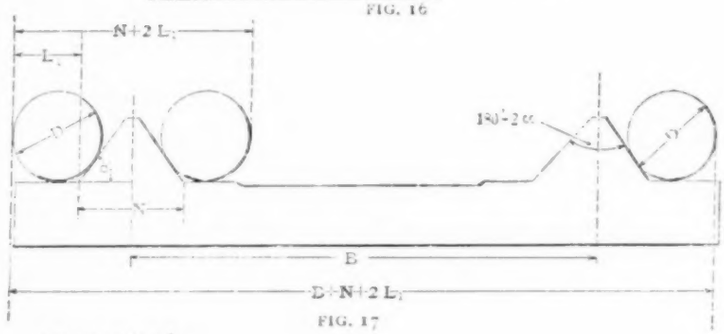


FIG. 17

MEASURING V'S

Dia. Wire = D	Width of V = N =	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8
3/8"	L_2 =	.2652	.2339	.2027	.1714	.1402	.1089	.0777	.0152	.0473	.1098	.1723	.2348
1/2"	L_2 =	—	—	.3536	.3223	.2911	.2598	.2286	.1661	.1036	.0411	.0215	.0840
5/8"	L_2 =	—	—	—	—	.4419	.4107	.3794	.3169	.2544	.1919	.1294	.0669
3/4"	L_2 =	—	—	—	—	—	—	.5303	.4678	.4053	.3428	.2803	.2178
1"	L_2 =	—	—	—	—	—	—	—	—	.7071	.6446	.5821	.5196
1 1/4"	L_2 =	—	—	—	—	—	—	—	—	—	—	.8839	.8214
1 1/2"	L_2 =	—	—	—	—	—	—	—	—	—	—	—	—
2"	L_2 =	—	—	—	—	—	—	—	—	—	—	—	—

Dia. Wire = D	Width of V = N =	1 1/2	1 5/8	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
3/8"	L_2 =	.2973	—	—	—	—	—	—	—	—	—	—
1/2"	L_2 =	.1465	.2715	.3965	—	—	—	—	—	—	—	—
5/8"	L_2 =	.0044	.1206	.2456	.3706	.4956	—	—	—	—	—	—
3/4"	L_2 =	.1553	.0303	.0947	.2197	.3447	.4697	.5947	—	—	—	—
1"	L_2 =	.4571	.3321	.2071	.0821	.0429	.1679	.2929	.4179	.5429	—	—
1 1/4"	L_2 =	.7589	.6339	.5089	.3839	.2589	.1339	.0089	.1161	.2411	.3661	.4911
1 1/2"	L_2 =	1.0607	.9357	.8107	.6857	.5607	.4357	.3107	.1857	.0607	.0643	.1893
2"	L_2 =	—	—	1.4142	1.2892	1.1642	1.0392	.9142	.7892	.6642	.5392	.4142

TABLE 3. VALUES OF L_2 (FIGS. 15 AND 16) FOR 90 DEGREE V'S WHERE N = WIDTH OF V AND D = DIAMETER OF WIRE

for determining the center distance of the two V's; toolsetting spots have been provided on top, to simplify the planing of the other side of the V's. To plane the V's of the roughing gage, the dimension required is $B+D$. The angle of the V has no influence on the measurements in this case, which is simply the center distance of the V's plus the diameter of the wire. The corners have been broken on the bottom as indicated in the sketch, to serve as a roughing gage for the female part also.

The finishing gage, Fig. 15, requires the dimensions $B+D$ (like the roughing gage) and L_2. Dimension $B+D$ controls the center distance of the V's, and L_2 the width N, which should be given on the drawing. The measurement L_2 can be taken in two different ways, as shown in Figs. 15 and 16, according to the measuring outfit at hand.

Convenient Tables

Tables 3 and 4 have been worked out for dimension L_2, considering different widths of V's, different diameters of wires and angles of 90 degrees and 120 degrees, using the formula:

$$L_2 = \frac{\frac{D}{2}}{\sin.\ \frac{a}{2}} + \frac{D}{2} - \left(\frac{N}{2}\ cot.\ \frac{a}{2}\right).$$

The dimensions used for the measuring principle shown in Fig. 16 are marked on the table with a circle (o). After the wire reaches a size where it strikes the parallel, the method of Fig. 15 has to be applied. For Fig. 16 the formula has to be altered and reads:

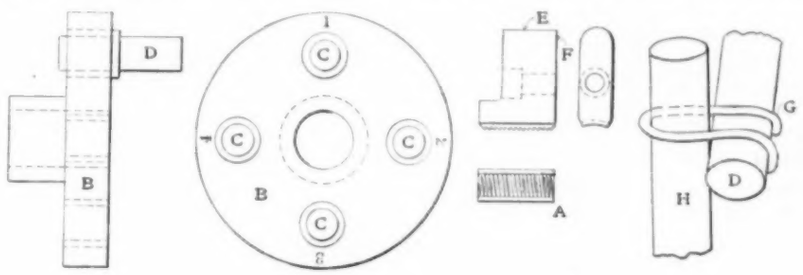
$$L_2 = \frac{N}{2}\ cot.\ \frac{a}{2} - \left(\frac{\frac{D}{2}}{\sin.\ \frac{a}{2}} + \frac{D}{2}\right).$$

The finishing gage for the female slide, as illustrated in Fig. 17 requires dimension L_1, which is given under Table 2. As stated above, the female gage should be fitted to the male gage, and for this reason the table has not been figured for 30 degrees (or for a V of 120 degrees) as it will be needed very seldom.

Hobbing Die Chasers

By E. A. Dixie

The chasers shown at A are used in a die head made by the Modern Tool Works, of Erie, Penn. A set of these chasers consists of four pieces, marked respectively, 1, 2, 3 and 4, fitting similarly marked slots in the body of the die head. They are cut on an engine lathe with a few simple but accurate fixtures.



HOBBING DIE CHASERS

The hob used is similar to other hobs, except that the position of the tail of the dog which drives it always bears the same relation to the thread, so that duplicate chasers can be made at any time with the assurance that they will fit. The face, or driver plate, shown at B, has four hardened-steel bushings C accurately spaced 90 degrees apart. A hardened-steel pin D is lapped to fit the lapped holes in the bushings C. This pin drives the dog on the hob. The lathe is of course geared the same pitch as the hob.

Mounted on the carriage is a simple fixture with stops on it. The die blank is clamped on the fixture with the faces E and F against the stops. The plug D is put in the hole marked 1 for the first chaser. A stop on the cross feed determines the depth to which the chaser is hobbed. For the second, third and fourth chasers the plug is moved to the holes 2, 3 and 4. The stops on the fixture secured to the carriage of course remain in the same position for all four chasers. A little clip G made of spring brass wire, holds the tail of the dog against the plug D when the lathe is reversed to take a new cut. This is shown to the right. G is the clip, D is the plug and H is the tail of the dog.

The two ends of the wire clip G are easily swung over the plug D. The only strain on the clip is during the reverse, and at that time all it has to resist is the friction of the dead center and the inertia of the hob and dog.

Dia. Wire = D	Width of V = N =	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2
3/8"	L_2 =	.2958	.2777	.2597	.2416	.2236	.2055	.1875	.1514	.1153	.0793	.0432	.0071	.0290	.1012	.1734
1/2"	L_2 =	—	—	.3943	.3763	.3583	.3402	.3222	.2861	.2500	.2139	.1778	.1417	.1057	.0335	.0387
5/8"	L_2 =	—	—	—	—	.4929	.4749	.4568	.4208	.3847	.3486	.3125	.2764	.2403	.1682	.0960
3/4"	L_2 =	—	—	—	—	—	—	.5915	.5554	.5193	.4833	.4472	.4111	.3750	.3028	.2307
1"	L_2 =	—	—	—	—	—	—	—	—	.7887	.7526	.7165	.6804	.6443	.5722	.5000
1 1/4"	L_2 =	—	—	—	—	—	—	—	—	—	—	.9859	.9498	.9137	.8415	.7693
1 1/2"	L_2 =	—	—	—	—	—	—	—	—	—	—	—	—	1.1830	1.1108	1.0387
2"	L_2 =	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.5774

Dia. Wire = D	Width of V = N =	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/2	5	5 1/2	6	6 1/2	7
3/8"	L_2 =	.2455	.3177	—	—	—	—	—	—	—	—	—	—	—	—
1/2"	L_2 =	.1108	.1830	.2552	.3273	—	—	—	—	—	—	—	—	—	—
5/8"	L_2 =	.0238	.0484	.1205	.1927	.2649	.3370	.4092	.4814	—	—	—	—	—	—
3/4"	L_2 =	.1585	.0863	.0142	.0580	.1302	.2024	.2745	.3467	.4910	.6354	—	—	—	—
1"	L_2 =	.4278	.3557	.2835	.2113	.1392	.0670	.0052	.0774	.2217	.3660	.5104	.6547	—	—
1 1/4"	L_2 =	.6972	.6250	.5528	.4807	.4085	.3363	.2642	.1920	.0477	.0967	.2410	.3854	.5297	.6740
1 1/2"	L_2 =	.9665	.8943	.8222	.7500	.6778	.6057	.5335	.4613	.3170	.1727	.0283	.1160	.2604	.4047
2"	L_2 =	1.5052	1.4330	1.3609	1.2887	1.2165	1.1443	1.0722	1.000	.8557	.7113	.5670	.4227	.2783	.1340

TABLE 4. VALUES OF L_2 (FIGS. 15 AND 16) FOR 120 DEGREES V'S WHERE N = WIDTH OF V AND D = DIAMETER OF WIRE

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Different Ways of Doing the Same Job—A Comparison of Methods, and Labor Costs, when Used as a Basis for Estimating

Doubtless the majority of our wandering mechanics will have noticed, and commented, on the totally different methods adopted for doing the same job by different firms up and down the country, each firm generally claiming some advantage for their particular method of procedure. Even although two different firms are considered of equal standing in their particular branch of the trade, it is interesting to note, that what one firm swears by, the next one will sometimes call bad practice, nor does the matter end there, as not only do their methods of operation differ, but the cost of production varies considerably on the same piece of work, a very important item in these competitive days.

Having seen flagrant cases daily cropping up, the man in the shop generally asks himself, what are the methods of fixing the selling prices for standard manufactures, which do not fluctuate according to the workman's time spent on them? And also what proportion does the actual labor cost bear in proportion to the finished product? A comparison is most interesting and in some cases amusing.

Figs. 1 and 2 show a forged-steel crossbar, for a steam stop valve, machined all over. I have seen these done on a slotting machine, round the edges *A*, *B* and *C*, taking 3¼ hours each. I have seen the same crossbar done by firm No. 2, on a vertical milling machine in 1 hour, with a less rate of hourly wages. Firm No. 1 cut the square thread on the brass spindle for operating through the crossbar on an engine lathe, taking 1½ hours each, whereas firm No. 2 milled a similar thread in exactly 12 minutes. Both firms claimed the same high standard of workmanship for their valves. The cost of production by firm No. 1 is about 250 per cent. higher than firm No. 2, yet firm No. 2 actually charges a net price of 20 per cent. more than No. 1. This looks very strange on the face of it. Even though firm No. 2 has a more expensive and up-to-date plant than No. 1, and consequently higher establishment charges, that does not account for the great difference. The question then takes this shape, that firm No. 1 are satisfied with a less profit than firm No. 2. This is sometimes the case, and also that when the articles are not made on piecework a large amount of guessing usually takes place when estimating and giving in tenders, the difference between the various firms often amounting to 200 per cent. difference for the same article; the better organized firms generally being the lowest, due to their improved method of cost estimating, and consequently they reap their reward by securing a large percentage of the orders to be given out.

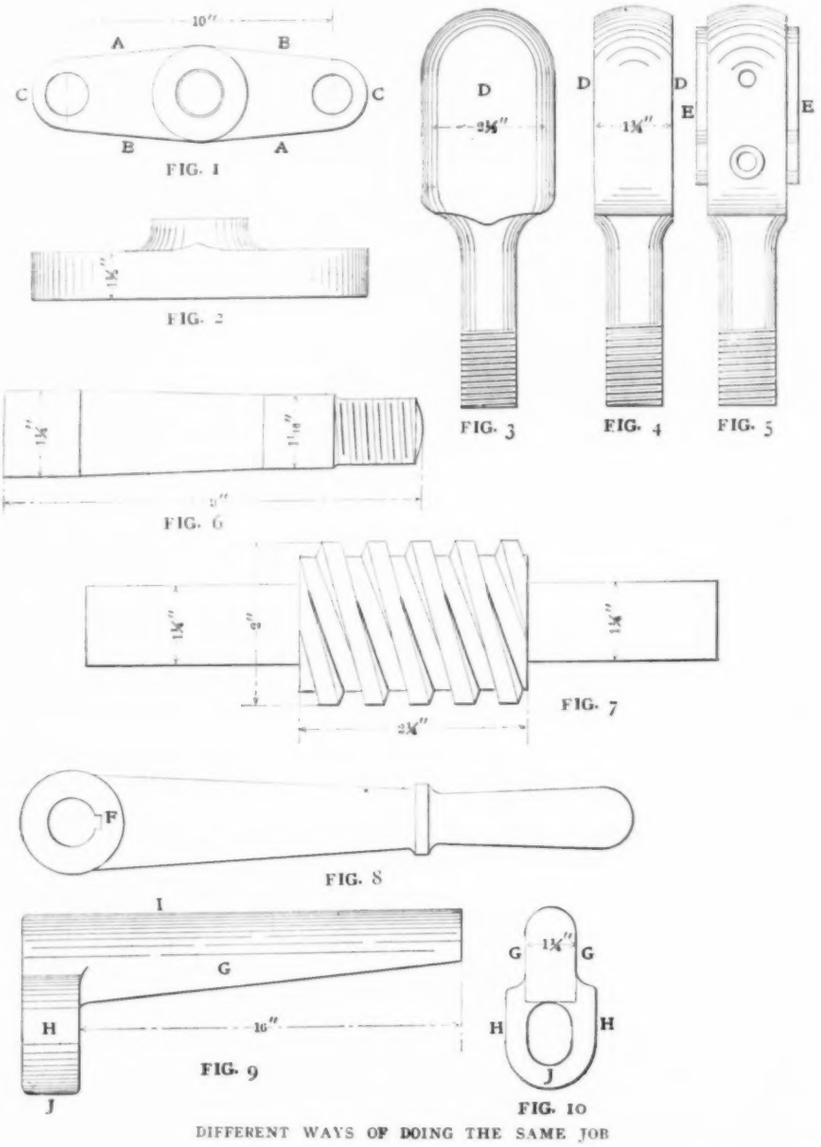


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9 FIG. 10

DIFFERENT WAYS OF DOING THE SAME JOB

Figs. 3, 4 and 5 show the valve-gear rods for a corliss engine. These require turning and threading on the shank and also machining to width on the two faces *D* to receive the brass bushes and adjusting wedge, marked *E* in Fig. 5. Firm No. 1 shapes them in 1½ hours each for the two operations, rod end and brass bearing; firm No. 2 does them between centers on a vertical miller in 18 minutes each and saves much time in filing up and polishing. Of course this is only a detail, but still the details, when added together, make a very perceptible difference in the total. Fig. 6 shows a steel swivel axle pin for the steering gear of an automobile. Firm No. 1 did these in a flat-turret lathe at a cost of three pence each; firm No. 2 did not consider that method accurate enough, and paid two shillings each for doing the same pin on an engine lathe. Both firms had the same system

of inspection. After paying no dividend to the shareholders for two years, firm No. 2 decided to cheapen production, and now do these on a flat turret; they still undergo the same rigorous inspection and pass muster. Fig. 7 shows a double-thread worm for a chain hoist. Firm No. 1 cut these on a thread miller at a labor cost of one penny each. Firm No. 2 cut them in an engine lathe and paid exactly one shilling each, yet firm. No. 2 sell their chain hoist at 40 per cent. less price than firm No. 1. The designs are dead copies of each other and the quality about equal. Are the selling prices based on labor costs? I think not.

Fig. 8 shows a steel hand lever with a small keyway cut in the bore as shown. I have seen dozens of these cut on a keyway-cutting machine operated by hand at one penny per dozen for labor, another firm not many miles away pays one penny each, and does them on a power-driven slotter, such is the difference of methods.

Figs. 9 and 10 show a cotter made of forged steel. I have seen these milled all over to size complete on a lincoln miller at a labor cost of six pence each, and I have also seen a shop in the same town do the same size cotter on a shaper, costing three shillings in labor, and then taking a fitter 2½ hours to file it up smooth after shaping. These are actual facts, which have come under my personal observation, and can be multiplied by the score. They form an interesting comparison, when side by side, and make one wonder how selling prices are sometimes fixed, and also how some firms manage to make a profit at all.

England. SYDNEY LAURENCE.

A Screw-slotting Fixture

We have a great many screws of various kinds and sizes to slot, so devised the semi-automatic fixture for use on milling machines, as per drawings furnished.

Fig. 1 is a side elevation of the fixture and milling machine (milling machine outlined in faint lines). The screw, or work-holding revolving disk *B* has 18 openings in the inner edge, this edge overhanging so as to permit the sliding-block openings to be milled entirely through. A cast-iron ring *C* is fastened to the disk *B* by means of three screws through lugs, as well as by three body-fitting screws *D*, Fig. 2. Openings are provided in ring *C* to match with the openings in the sliding block *F*, Fig. 3.

Disk *B* has an ample bearing in the supporting casting, and also has the worm wheel at the outer end of the bearing. The pitch of the worm and worm wheel are such as to revolve the work-holding disk three turns per minute, when the feed belt is upon the intermediate step of the feed-cone pulley, the milling-machine spindle making 80 turns per minute. The worm shaft is connected by miter gears, universal joints and telescope shaft to the feed-cone pulley. The miter gear *E* runs in a yoke that swings upon the worm-shaft bearing, and is locked, when adjusted, by a clamping bolt shown; by this means the alinement of the driving shaft is better. The worm box is cast with the supporting casting and has a cover.

Fig. 2 is a front elevation of the milling machine, but shows the back of the attachment. On getting the attachment ready for business the supporting casting can be clamped to the milling-machine table somewhere near the center of the milling-machine spindle, the exact adjustment being accomplished by means of the table and cross-feed screws. When properly adjusted the table is locked. Suitable covers have been provided for all miter gears, so that any danger of the operator's fingers and gears getting "mixed" is impossible.

Fig. 3 is a section at *A A*, Fig. 1, showing the parts in place; the sliding block *F*, together with the work-holding jaws *G G*, as well as the actuating springs, are shown. The spring in the revolving disk holds the sliding block *F* back to the disk at all times, except just before the work and slotting saw come in contact, and until the work has left the saw, and the plunger *I* and pressure disk *H* are no longer in contact. No two plungers are in contact with the disk *H* at the same time. Fig. 3 shows the work as passing under the saw. The pressure spring, shown at the left, is of sufficient strength to overcome the weaker spring and to firmly hold the screw while passing through the saw. A nut is provided at

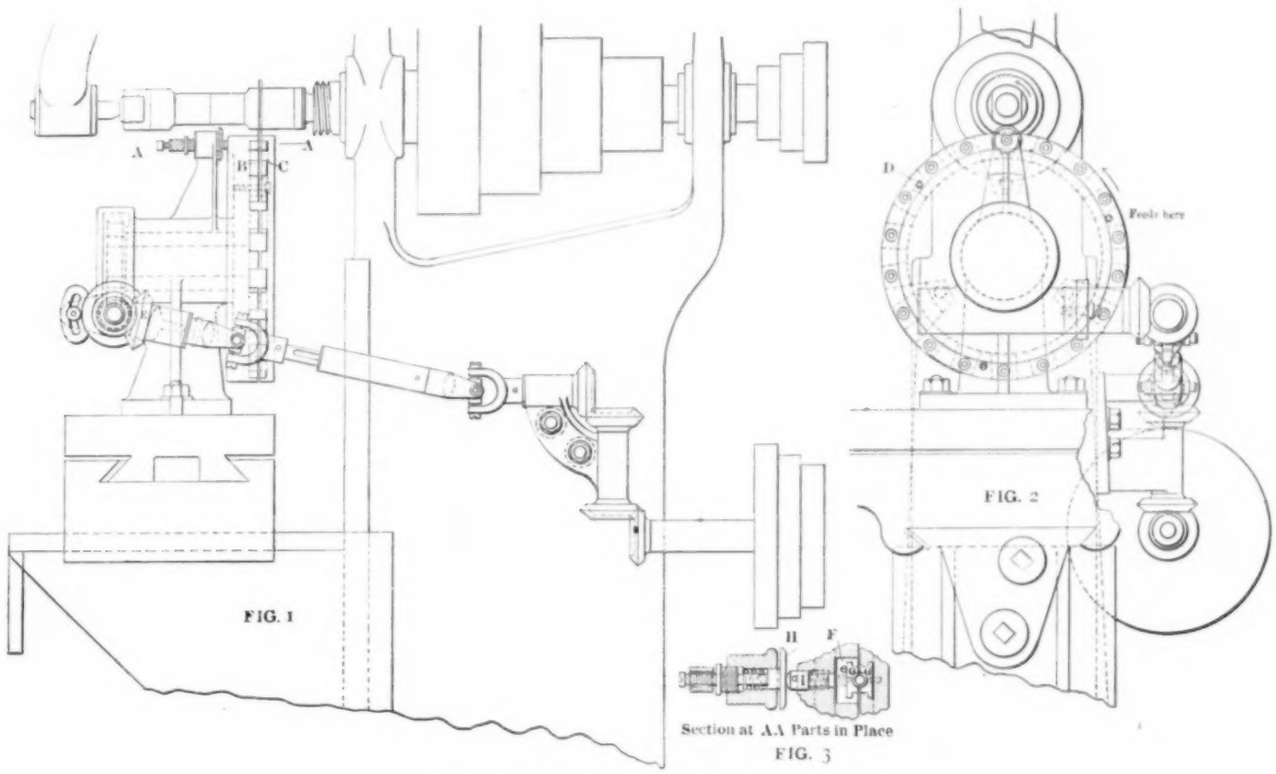


FIG. 1

FIG. 2

FIG. 3

MILLING-MACHINE ATTACHMENT FOR SCREW SLOTTING

the outer end of the spring so that the pressure can be increased when desired; this nut is moved by the spanner wrench. It will be noticed that an outer nurled nut (for adjustment) is provided upon the stem of the contact disk *H*, so that the travel of the contact disk *H* can be regulated, and this is necessary, for should the pressure nut be screwed well into the casting the travel of the contact disk would be too great. The nurled nut is locked by a screw coming in contact with the end of the stem of the contact disk *H*. This disk is made of tool steel and hardened. The plunger *I*, shown in contact with the disk *H*, passes through the weak spring and is screwed into the sliding block *F*; this plunger is also of tool steel and hardened at the contact end. The work-holding grip blocks *G G* are jig milled, jig drilled, and then parted with a thin saw. The blocks shown are for ¼-inch fillister-head screws. These blocks, as well as the sliding block *F*, are made of machinery steel and pack hardened. *G G* are milled an easy sliding fit into the castings and block *F*, a pin at the inner end holding the outer end flush with the castings, a small fillister-head screw holding them in place. A brass band encircles the revolving disk *B*, covering a good portion of block *G*, so as to prevent all dust and dirt from getting in between the sliding block *F* and disk *B*.

The "cub" operator feeds the screws into the revolving grip blocks at about the place marked at Fig. 2, the screws leaving the grip blocks by gravity and entering a chute when nearing the lower opposite side.

We always find that the "cub" can slot more screws when working by the so-much-a-hundred plan than otherwise, as fewer grip blocks pass the saw empty. From 3500 to 4000 screws can be sawed per hour by this attachment; the number is limited by the boy's ability to handle screws.

Any old milling machine is just as good for this work as one just from the factory. The fixture is put upon or taken away from the milling machine in a few minutes.

Providence, R. I. E. Beck.

Milling Attachment for Milling Featherways in Saw Collars

We all know, or at least we who have had it to do, know what a difficult job it is to cut two feather- or keyways in a collar and have it slide over the keyways in the shaft.

By this I do not mean that it is a difficult job for a toolmaker to take one piece and spend three or four hours on it and get it right, but for the man in the shop who gets them in lots of 50 or more and has to get them out in a limited time it is a different proposition.

We used to cut all of ours on the slotter, and although we tried all kinds of tools, we met with very little success.

Every time the foreman of the assembling department had a set of them to fix up we of the machine shop heard from him, and generally two or three of the set had to be thrown away, and the apprentice who did the job had to get another calling down. This sort of thing went on until I hit upon the idea of doing the job on the milling machine, and then my troubles, or that particular part of my troubles (for a machine-shop foreman never gets rid of all his troubles until he dies) were at an end.

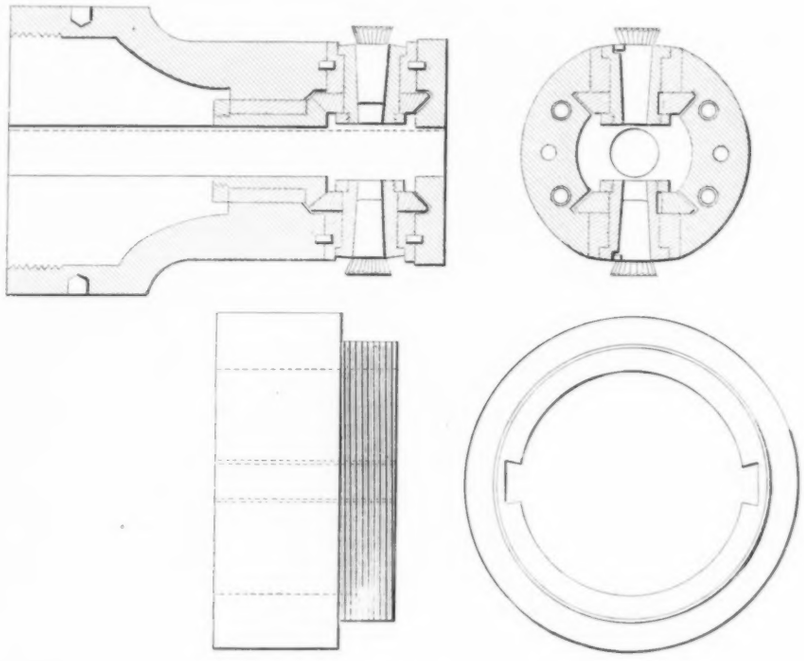


FIG. 1. THE ATTACHMENT IN SECTION

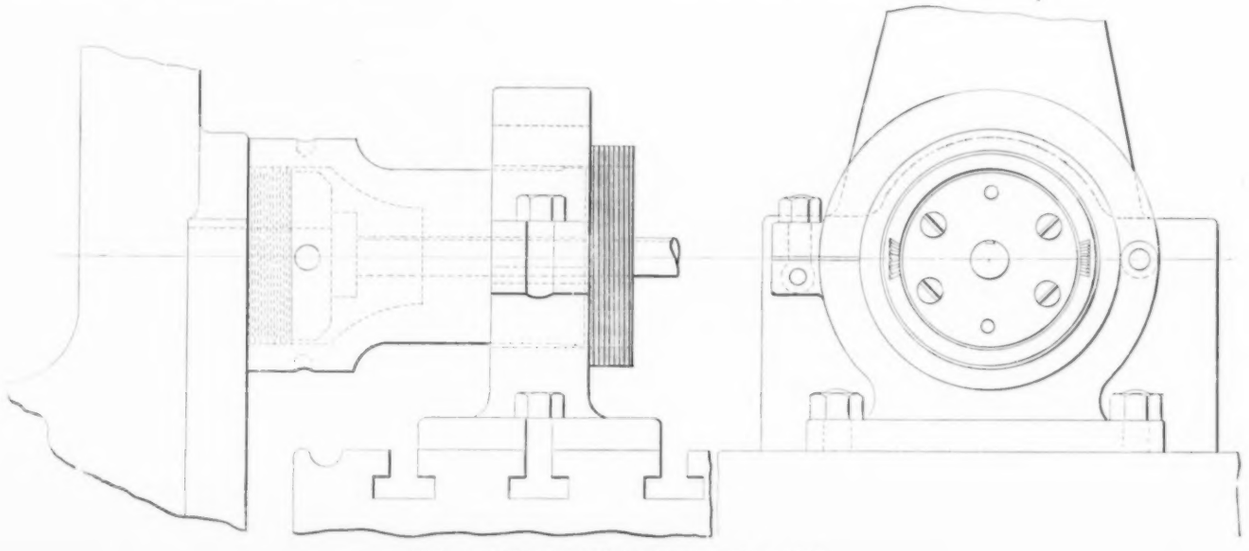


FIG. 2. THE ATTACHMENT AND THE WORK

Fig. 1 shows a sectional view of the attachment which was used to do the job, and the work to be done, and Fig. 2 shows the attachment and device for holding the work on the milling machine.

It was made to fit on a Becker-Brainard milling machine by removing the nut from the outside of the front bearing and screwing it over the bearing in place of the nut, but this part could easily be arranged to fit any style of machine. The body is made in two parts and held together with four 3/8-inch fillister-head screws and two small dowel pins. The front part of the body or pilot is turned a good fit for the bore of the collar to be keywayed and the part behind the cutters is turned small enough to allow the chips to get out freely.

The cutters are fitted into steel sleeves which are driven by bevel gears and run in brass-bearing sleeves; these brass sleeves are split so that by removing the pilot the gears and sleeves can be taken apart in a few minutes.

Both gears are driven by one bevel gear, which also runs in a brass sleeve, and is bored and keyed to fit the milling machine arbor. The clamp for holding the work is fitted into the slots of the table so there is no question about getting it set up square, and bored so that it will tighten up on the outside of the work. It has a hinge in the back, and is tightened up by the nut on the swivel pin in front, so it is only necessary to loosen the nut enough to swing the swivel pin over and lift the top half of the clamp up to remove the work. The collar this was designed to mill had a 4-inch bore, but there is no reason why it cannot be made for collars with a much smaller bore by using a smaller arbor and making it smaller all around.

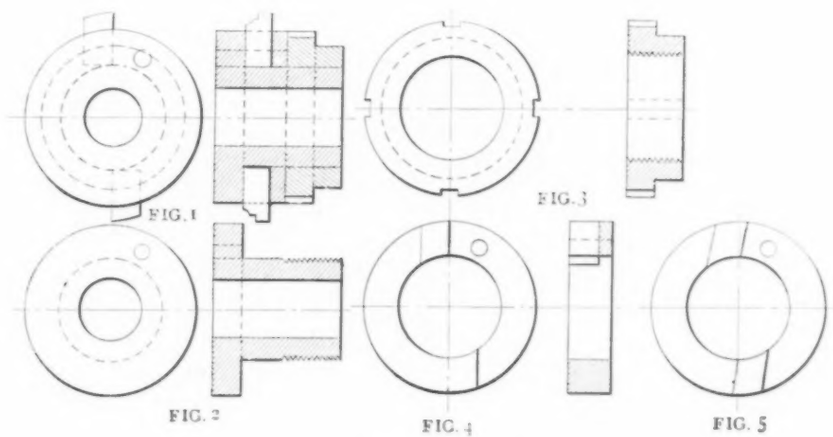
If the pilot is made to fit the bore of the collar it is impossible to get anything but a good job, and that in a few minutes, where it used to take hours to get a job which was fit only for the scrap pile.

Madison, Wis. W. M. L.

A Fly-cutter Arbor

The accompanying drawings show a tool designed to take the place of the ordinary fly cutter used on the milling machine for various odd jobs of irregular shaped milling. The drawings show the tool assembled and in detail. The tool itself is composed of three parts exclusive of the cutters, the body Fig. 2, lock nut Fig. 3 and distance piece Fig. 4. The body was bored to fit one-inch mandrel and was made of machine steel threaded on the end to within 5/8 inch of the shoulder so as to allow plenty of draw. The nut was also made of steel and slotted as shown for the spanner wrench. I might also say that a fine thread should be used, about 16 per inch. The distance piece Fig. 4 was also made of steel finished all over and milled as shown to receive 1/2-inch Novo steel cutters. The hole shown is to prevent the cutters turning and wearing the body piece.

Fig. 5 shows another distance piece but for use in the lathe to turn the cutters to the required form. The angle of the slot must depend on the work though I made mine about four degrees. It will be noticed after the cutters are turned and changed to the other distance piece that they have clearance and also that they can be sharpened without changing their shape.



A FLY-CUTTER ARBOR

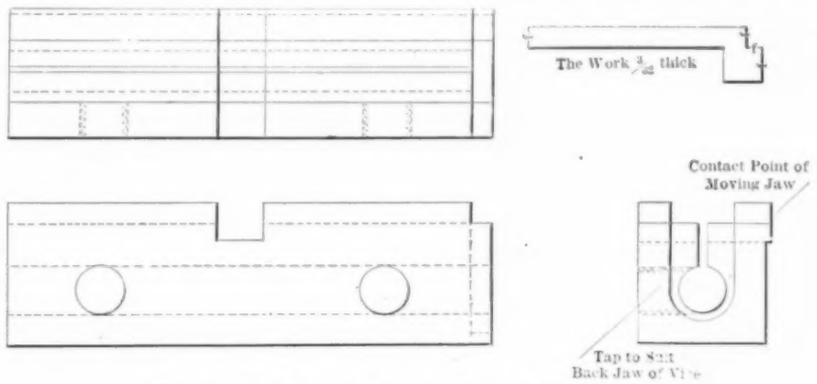
This tool may not be new but I designed it knowing of nothing like it. To turn the cutters you simply put your tool complete on a mandrel using the distance piece having a slot at an angle and go ahead. Another advantage about this tool is that to use different size steel you simply make two new distance pieces instead of a complete new arbor.

Yonkers, N. Y. R. G. D.

Special Spring Vise Jaws

Any person who has ever used special vise jaws has had more or less trouble in using them, for the reason that most every time they are taken off and put on again, it is impossible to get them to lie in the vise in the proper way.

I show herewith a special vise jaw made in one piece, which can be depended on to give most satisfactory results as regards accuracy and speed.



SPECIAL SPRING VISE JAW FOR USE ON MILLING MACHINE

This jaw is made of one piece of tool steel, and takes the place of the back and front jaws, the difference between this jaw and the regular vise jaws being that this one only screws on in the back, and being split, makes it act as a spring.

As can be seen by the illustration this jaw was made for a gang mill of three milling cutters, making one operation. The piece to be milled is put in the jaw, and the movable jaw on the vise is closed up against it, and the jaw being split allows it to close in on the work, thus holding the work to perfection.

In making the jaw it is first milled on the four sides, and then put in the vise again after taking off the regular back jaw.

Next thing to do is to transfer the holes in the back of the vise into the special jaw. It is then taken out and the holes tapped. The jaw is then screwed in position, taking care that it lies firmly on the bottom of the vise. After this has been accomplished, it is then milled as desired while in position. The long hole shown through the entire length of the jaw is drilled next, and following this the jaw is then split.

This jaw has overcome all our troubles.

Brooklyn, N. Y. E. J. RANTSCH.

Cutting Oil Grooves on the Universal Milling Machine

We had a large quantity of connecting-rod bearings and long bushings to have oil grooves cut in them; to have used a hammer and chisel on the bushes would have been almost out of the question.

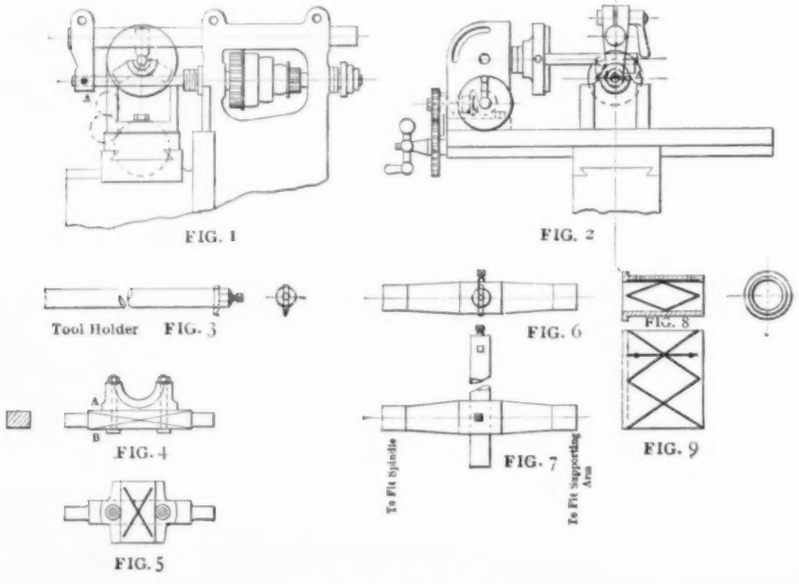
The rig for the connecting-rod bearing was composed of a tool bar as shown in Fig. 3 and a bar or bridge for supporting the bearings as in Figs. 4 and 5. The finished work would appear as shown in Fig. 5. The rectangular bar or bridge is turned at each end so that one end fits freely into the spindle of the machine while the other end fits the steady arm and is secured by a set screw as shown in Figs. 1 and 2. The bearing is bolted to the bar or bridge as shown in Figs. 4 and 5, and the tool bar is placed in the universal chuck of the index head, taking care that the work is central with the index head.

To cut grooves in the bushes we reverse matters, instead of the tool bar being held by the universal chuck of the index head, we place the bushing there and the tool bar is held in the tool-bar holder as shown in Figs. 6 and 7, the idea being to get the tool bar at right angles to the machine spindle or in line with the work.

The bearing would appear like Figs. 8 and 9, Fig. 9 being the bore of the bushing developed. The change gears for the spiral of the grooves would be found near enough by taking twice the length of the bearing and calling it one turn in this length; for instance if the work was 6 inches long we would term one turn in 12 inches and looking up the change-gear tables we would find the gears required.

This rig made a most beautiful job in good time.

Brooklyn, N. Y. S. A. R.



CUTTING OIL GROOVES

A Bar for Boring Spherical Seats

I was once called upon to design a rig for boring spherical seats in electric-motor heads for self-alining bearings. The stunt was a new one to me as I had never seen anything similar from which to start a line of thought. However, this is what I worked out and it proved very efficient, boring the seats to the 1/1000-inch limit and doing nice, smooth work. Fig. 1 shows the rig complete. But to give a better understanding of it, we will describe the method pursued in machining it.

Fig. 2 shows the bar of iron casting in cross section; at *A* was inserted a false center. The opposite end *B* being solid, needed no false center. After centering it was put into the lathe and just trued up at *C* and *D*; next onto the milling-machine centers and the slot cut at *E*, Fig. 1, for receiving the tool carrier; also on the opposite side *E'*, Fig. 1, for the tool carrier and connecting rod; then

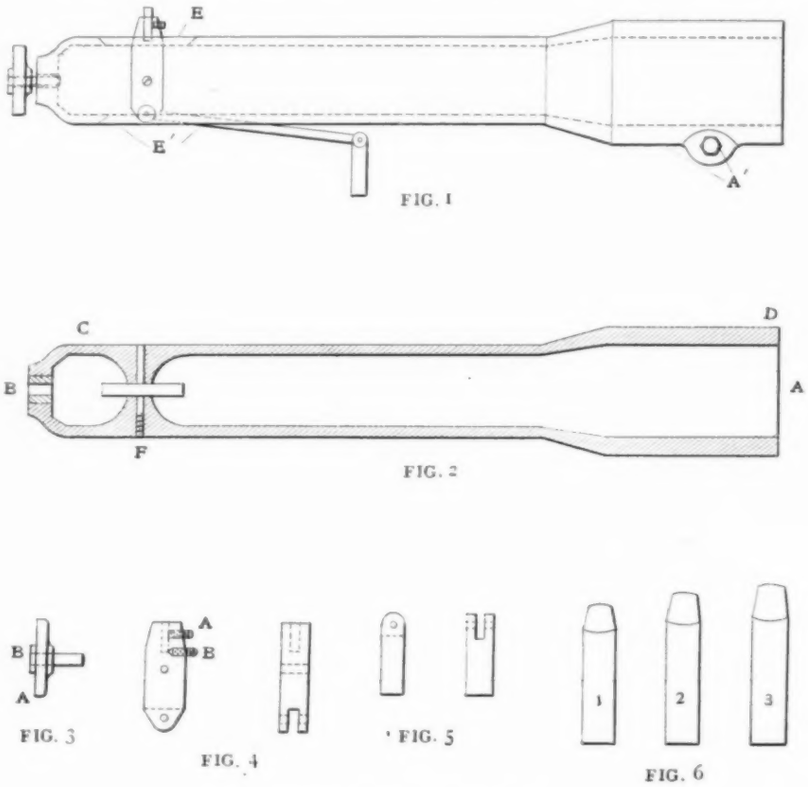


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

BORING BAR FOR SPHERICAL SEATS

with one quarter turn of the dividing head and adjusting the table longitudinally and vertically we are in position to drill, ream and tap the hole at *F* for the pin on which the tool carrier swivels. *A* was then put onto the live center of the lathe with *C* in the center rest and bored out at *B* for a hardened and ground steel bushing. Then after removing the false center from *A* and placing *B* on the live center with *D* in the center rest it was bored at *A* to fit nicely the tailstock spindle on which it was to be used. The slot at *D*, Fig. 1, was next sawed and the hole drilled and tapped for the clamping bolt.

Fig. 3 is a cast-iron plate faced at *A*, and the boss at *B* turned to fit a recess in the face plate of the lathe on which it was to be used. It was then fastened to the face plate by three fillister-head screws and bored for the pin shown—a force fit. The pin is hardened and ground, and is a running fit in the bushing shown

at *B*, Fig. 2. Fig. 4 shows the tool carrier, made of tool steel and hardened. The screw at *A* is for securing the tool in position, and the pointed screw *B* for adjusting it. The other parts need no explanation.

In operation the motor heads were bolted onto the face plate of the lathe; the boring bar put onto tail-stock spindle; the tailstock pushed forward to bring the center of the tool carrier to the center of the seat to be bored; the tailstock secured to the latheways and the boring-bar connecting rod fastened to the piece, Fig. 5, in the tool post by the taper pin.

The lathe started backward and throwing in the feed of the carriage caused the tool carrier to make its circular sweep as per dotted line at end of cutting tool, Fig. 1.

One of the most important points of the whole fixture are the cutting tools, Fig. 6. They were made of drill rod in three different lengths—No. 1 for roughing, No. 2 one-sixteenth longer for semi-finish, and No. 3, one sixty-fourth longer than No. 2 for finishing. The advantage of this method is readily seen; as after once adjusting the finish tool, and being ground on their faces instead of on the ends, the diameter of the bore was maintained with very little trouble. A record of the length of each tool was kept and duplicates also, so that when a tool was broken it was replaced and no adjusting was necessary.

To change tools simply remove taper pin from the piece in the tool post, shove the tailstock back leaving the bar clamped to it. When the proper position of tailstock relative to center of spherical seat has been once obtained, by clamping a piece to the ways of the lathe and abutting the tailstock the bar can be withdrawn and returned to position without delay.

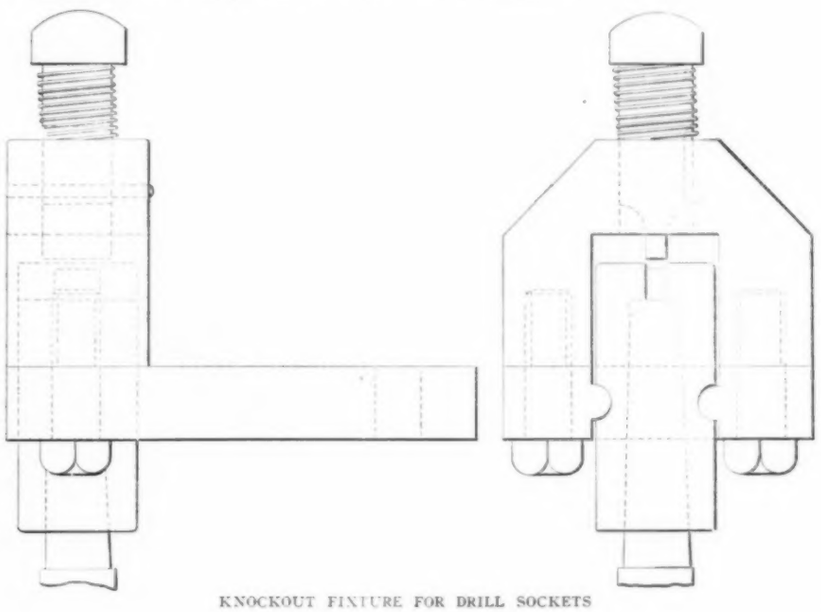
Buffalo, N. Y. A. NEWMAN.

Knock-out Fixture for Drill Sockets

The use of sockets on machine tools has become a regular thing. Some of them have the drift hole for removing the tools, and others are slotted at the top like the one shown.

It was for the latter kind that the fixture here shown was made. The half-round grooves in the socket are used in driving it.

Both parts are of steel to resist the blow of the hammers.



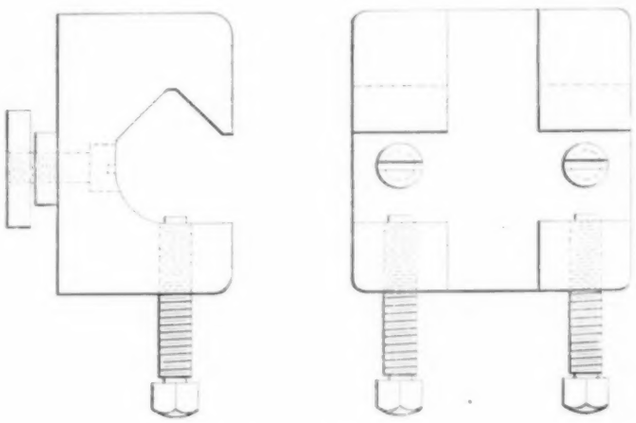
KNOCKOUT FIXTURE FOR DRILL SOCKETS

To remove taper shank tools from sockets, they are slid on the projections of the lower plate, then a sharp blow from a hammer on the hardened drift knocks out the tool. The coiled spring returns the drift to its proper place. A small pin and a flat on the drift keeps it in the proper location and also prevents it from springing out.

Cleveland, Ohio. H. T. GREEN.

A Holder for Bar Tools

The illustrations require but little description. These holders should be made of steel, either cast or forged, in preference to cast iron, and the V's should be accurately machined, in perfect alinement with the lathe centers, so that drills, reamers, and other finished tools can be held properly. The limit as to size of bar used will depend on the hight of the center from the cross slide, it being advisable to keep the base as heavy as possible.



A HOLDER FOR BAR TOOLS

The one shown was made for a 24-inch Pond lathe, the sketches being quarter size, and would hold anything from ½ inch to 2½ inches diameter; it was strong enough for any work the lathe would handle.

By having a few tools made of round stock for facing it will seldom be found necessary to remove the fixture from the cross slide while doing any sort of chuck work, and I am satisfied that a trial of it will convince any lathe hand of its general all-around efficiency.

Elyria, Ohio. C. H.

Eraser for Higgins' Ink

It may not be generally known by the readers of the AMERICAN MACHINIST that *spirits of camphor* is one of the best liquid erasers in existence for removing Higgins' ink from tracing cloth. In fact it is all that can be desired. I learned of this fact by accidentally overturning a bottle containing the liquid on a tracing.

The only precautions necessary in using it are to place a piece of blotting paper under the tracing at place of erasure and not to rub too hard. Apply with a small sponge or a piece of clean cloth.

Holland, Mich. E. W. CLEVELAND.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

A Kink in Hardening High-speed Steel

I was very much interested in E. R. Markham's experiments treating on high-speed steel on page 134. It recalls to the writer's mind some experiments I tried. We had running at that time a number of rifling machines (connected with the manufacture of rifles). This necessitated keeping on hand a large supply of rifling cutters, both of the scrape and hook style. We made some of the cutters out of high-speed steel, heated them in a small gas furnace suitable for small work, and dipped them in many different baths with varying results.

Among the many baths we tried, was clear cold water, quite the opposite of the strictly prescribed methods of the makers of the steel and the results were surprisingly satisfactory. They stood up better than the ones dipped in fish oil, especially the scrape cutters. A tool of good sized cross section would not, of course, stand this treatment, but in this particular case, where the piece was small, they did.

We had a very large number of tools made of high-speed steel, such as drills, reamers and cutters, with taper shanks where the length was very great in proportion to the diameter. We wished to retain the natural softness of the steel in the shanks through the hardening process. After experimenting with various non-heat-conducting materials, I tried common painters' putty, whiting mixed with linseed oil. This proved to be entirely satisfactory in retaining softness in parts desired and preventing oxidation. These tools were heated in a vertical furnace, they being held by a heavy wire, twisted around the body and shank, a generous coat of the putty being placed over the wire on the shank of the tool.

E. S. WHEELER.

Yonkers, N. Y.

Machining Eccentric Sheaves

On page 842, Vol. 30, Part 2, S. A. Ross gives a method of machining double-eccentric sheaves. Here is the method we use on the turret lathe, finishing single-throw sheaves in one operation. One of our chief products is a line of small high-speed non-reversing steam engines, on which the eccentrics have an eccentricity which varies from ½ inch to 1½ inches. Figs 1 and 2 show the work, on which a piece *a* is cast by which to grip the casting in the chuck; after the piece has been machined all over, *a* is parted off as shown. We require large quantities of these eccentrics. The chucking fixture illustrated will take any eccentricity from zero to 1¾ inches. In Figs. 3 and 4, *A* is a gray iron casting, threaded to fit the live spindle, in which *B*, made of machinery steel, slides at right angles to the axis of the lathe, on which the ordinary self-centering chuck is screwed to hold the work. *C* is the screw by which *B* is moved to and fro, working in a bronze nut attached to *B*. *F*, Fig. 4, is a locating screw, of which there are two, one at each end of the slide, not shown in Fig. 3, which are screwed through the pieces *D D*; they are provided with locknuts, and govern the movement of *B*.

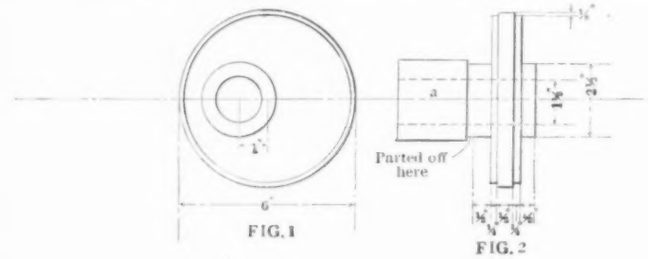


FIG. 1 FIG. 2

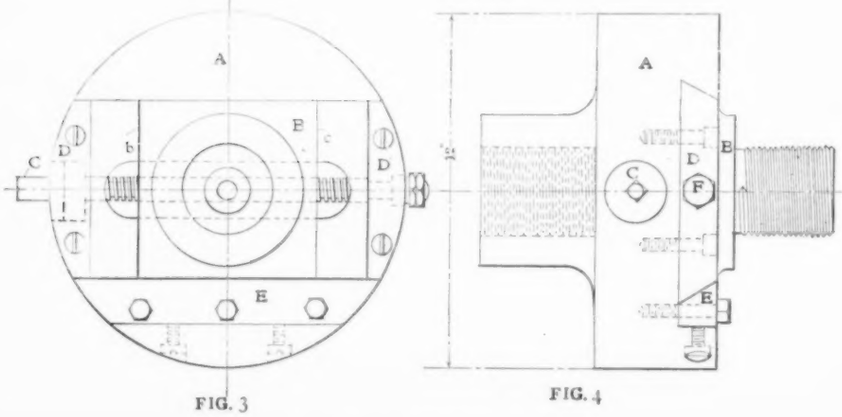


FIG. 3 FIG. 4

THE WORK AND THE FIXTURE

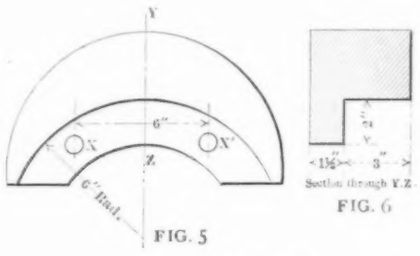


FIG. 5 FIG. 6

THE COUNTER BALANCE

E is the adjusting strip by which *B* is kept a very tight fit, as any chatter here would be disastrous to the work.

Figs. 5 and 6 show the kind of balancing weight used when the chuck is thrown out of center, two ¾-inch studs are screwed into the back face of chuck; these fit through the holes *X X'*.

The screw *E* is brought up to the face *b* when the spindle nose is central and the screw *F*, not shown, is set and locked to give the slide *B* the required eccentricity. The face *c* of the slide is then brought over to this screw and the balancing weight put on, the work chucked and turned over the outside diameter. The slide is then brought over central again, and the balancing weight removed, and work bored, faced, and parted off.

J. ESSEX.

London, England.

Taps with Spiral Flutes

In regard to Professor Sweet's suggestion, at page 387, as to making taps with spiral flutes, I want to say that the Pope Manufacturing Company, Hartford, Conn., made small taps in this way as far back as 1892 to my knowledge, and how much before that I do not know.

The taps were small hand taps used for

bicycle work, and gave perfect satisfaction, the flutes being cut right-hand with two flutes to a tap. I never saw one larger than 3/16 inch and do not know whether any were made, or whether they were ever tried in a machine.

Decatur, Ill. ETHAN VIALL.

Training Married Men

At page 280, R. E. Marks seems to take some exceptions to Mr. Alvord's desire to educate married men. Now I am married and Mrs. Entropy says that if she only knew who R. E. Marks was she would have some of his hair to stuff a new pillow that she is making.

We married men have got to get together and stop the way things are going. Not the hair pulling, for I know how to stop that and I will let any afflicted member of the fraternity in on it for a two-cent stamp, but this idea that once a man's married there is no longer any need of educating him; the idea that when he is married he is all in but the funeral. Why, man alive, that is just when most men begin to find out they need an education.

Before I was married I drew $12 a week and I was rich beyond the dreams of avarice. My expenses were about $8. The other $4 I had to lie awake nights to think up ways to spend. I worked as a matter of habit. When I married I discovered that $12 would not go a great ways, so I asked for more and got it so easy that I began kicking myself that I had not said anything about it before. But when I got it I began to worry for fear I was not making good. You see it was one thing to lose a $12 a week job with money in the bank and no one dependent on me and quite another to lose a thousand dollar a year job with a wife to call me to account.

I began to wake up to the fact that I did not more than half know what my employer thought I did. I was foreman then and I was depending a lot on some of my best men for things that I ought to have known myself. You can bet I just got down and hustled some to find out the whys and wherefores of a whole lot of things that I ought to have learned before.

Judging by my own experience and my experience with some boys that were not so far different from Mr. Alvord's boys you cannot expect to get very steady, conscientious, careful work from a man till he is married. Self interest is all that makes 90 per cent. of us work at all any way. Of course there are a few geniuses who would work 24 hours a day if they could and do it for nothing, but then genius is only a form of insanity. You see working for ordinary pay is easy money to a single man, not because he gets much, but because he needs to spend so little. Easy money is a sure cure for work, so what can you expect different from what Mr. Alvord found.

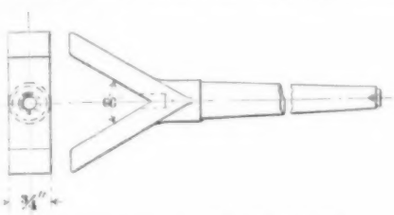
I think the old saying, that you cannot teach an old dog new tricks, is dead wrong, or else, what used to be an old dog is a young one now. Most men marry before they are 40, and I don't believe that they become old dogs till long after that. Worse than that, most of us do not discover that we got into the wrong pew till after we are married. Then we cannot go back and take apprentices wages at a new trade. And we are worth more than apprentice wages, if we are worth anything at all, for we know we have got to learn quick and we hear about it at home every night. We take an interest in what we are told and our habits of attention to detail have already been formed.

What we need is night-school instruction in trades and it will pay the community to furnish it. If you must do something for these harum-scarum boys that Mr. Alvord is kicking about, put them in a trade school and teach them how to do things. Don't expect too much in the way of nice work. Set up a girls' trade school alongside. Propinquity will do the rest with the result that you will soon have a lot of young men who know how to do things, settling down to do them right.

Fitchburg, Mass. ENTROPY.

Crosswise Holes Through Cylindrical Work

On reading Mr. Gribben's article on drilling holes crosswise through round rods, page 25, I was surprised to learn that this was considered such a difficult operation to perform. The methods described by Mr. Gribben will doubtless accomplish their purpose, but I do not see the necessity for going such a long way around to do it, nor any necessity for "doctoring" a hole after it is once drilled. In my practice as a toolmaker I have generally used one or other of the following methods, as the case required:



V DRILLING CENTER FOR LATHE

For ordinary jobs, such as described by Mr. Gribben, a fork or V center as shown in sketch is inserted in the tailstock of the speed lathe or engine lathe, and the drill held in a drill chuck or scroll chuck. The location of the hole to be drilled is laid out with a center punch and the work held lightly by the hand in the V center and brought up to the drill, which should be run as fast as the nature of the material being drilled will permit. By this method a hole true and central enough for all ordinary purposes may be obtained.

Where greater accuracy is required, the toolmaker's friend, the milling machine, must be called into play, using the index head. The index head can be accurately adjusted centrally with the spindle and parallel with the table and frame of the machine by a number of methods well known to the toolmaker, but preferably with the indicator. If the ends of the work are centered it may be held in the usual manner on the centers with a clamp dog. If not centered the work may be held in an ordinary chuck, or it may be necessary to provide a special arbor or chuck if the required accuracy or the shape of the piece to be drilled demands it. The work is then brought into position for drilling and the table securely clamped, then centered with a centering drill held in a drill chuck, then drilled, bored and reamed.

By a combined use of the graduated collar on the longitudinal screw, the index head and the gears for cutting helical grooves or flutes on the universal milling machine, a wide range of very accurate work may be obtained.

For example, the blanks for large milling cutters having round inserted teeth located helically on the periphery may be accurately located and drilled in this manner. On a universal milling machine, in addition to drilling centrally across cylindrical pieces, they may be drilled at any desired angle with the axis of the work, within the range of the machine.

There are a number of methods by which work of this description may be very satisfactorily performed in the engine lathe with the assistance of the indicator, but I think that the methods described herein will be found practical and accurate enough for most cases of this description.

Montreal, Can. WALTER I. JEHN.

Hardening Methods Criticized

In Vol. 31, page 126, of the AMERICAN MACHINIST, appeared an article headed, "Hardening Methods of a Large Shop," and it appears to me that this article needs considerable criticizing.

In the fourth paragraph Mr. Claver states that "for a tap or reamer to be of the best possible use, it must be a steel that will stand a severe shock without breaking." Now, as for taps, I must confess that we have overlooked the dangers of their breaking by a severe shock, having, in trying to make them "of the best possible use," paid more attention to the correctness of the diameter, pitch, and proper temper. With reamers, we rather expect them to be handled with "gloved fingers," so particular are we that these

tools shall be so made as to produce smooth, accurate holes. It is to be inferred that the taps and reamers of which Mr. Claver speaks are, perhaps, started with a sledge hammer, thus accounting for the severe shock.

In the second paragraph, under the sub-head, "Using up Old Dies," Mr. Claver, speaking of lead baths, says that these "made the company more money than any furnace in the hardening room," for the reason that "this fire is the only one that can be, or is, interfered with during the day, the others having their day's work laid out for them in the morning." It seems more natural to presume that the fires which are in constant use, heating routine work requiring the same treatment are the fires which "make more money" than those being interfered with. The temperature of a lead bath cannot be raised or lowered in an instant, consequently there is loss of time, also money, for the company.

Next we have "A Quick Hardening Job," and I consider the dexterity with which this was done as nothing short of marvelous. In comes the boy with a milling cutter—rush order—must have at once. Hardening man takes cutter, places it on "peculiarly bent rod," plunges it in the lead, hardens it, takes it to "oil-tempering fire" (thermometer registering 430 degrees Fahrenheit) and takes it out again. Time, "in less than two minutes by my watch."

Naturally, it must be taken for granted that the milling cutter referred to was a very small one, and that at the time the boy came rushing in, the lead bath happened to be of the proper temperature for heating this cutter. Even then it must have taken nearly a minute to heat it properly, leaving about a minute for drawing the temper. I have not, up to the present time, heard of a hardened piece of steel so receptive that it could be drawn to 430 degrees Fahrenheit in one minute.

In our experience, the best results are obtained by putting tools to be drawn into the oil-tempering furnace while the oil is at a low heat, say, from 100 to 150 degrees Fahrenheit, and let the heat of the oil and the tool rise together until the thermometer registers the proper heat. This is the better way to insure the tool getting the required temper uniformly through its whole body.

In the second column mention is made of heating circular saws 3 inches diameter and 0.030 inch thick in the lead bath. We have found that a box furnace, muffler, or similar furnace, in which there is no possibility of lead adhering to the sides of the saw, is the best suited for heating these tools. There is also less danger of warping.

Under the sub-head of "The High-speed Furnace," Mr. Claver speaks of putting numberless profile cutters, one after another, into a furnace already heated up to 1350 Centigrade. This should not be done. The high-speed steel, with the tools to be treated already inside the furnace, should be heated very gradually until the proper heat is reached. It is against good practice, no matter what kind of high-speed steel one has to deal with, to put a large number of tools into a furnace heated high. Pre-heating, in our experience, is safer and much less liable to cause breakage.

Under the next sub-head Mr. Claver says, "I thought that we had surely burned the flutes to the center, but after it was taken from the oil it was a nice steel-gray color and showed no effects of being in the fire." The statement about not showing any effects of being in the fire is contradictory to the rest of the sentence, for, did the reamer remain soft? and how about the "nice steel-gray color?"

Stamford, Conn. GEO. SCHOOL.

Why a Planer Should be Bolted Down

I am pleased to read what Mr Eberhardt, Mr. George and Mr. Noel have to say at page 137 in reply to my question, "Why is a Planer Bolted Down?" Mr. Eberhardt has told us why there should be some provision to prevent certain planers, under certain conditions, from moving on the foundation in a line parallel with the motion of the table, but he has not told us why such a planer should be bolted down, neither has he told us why for all these years, and at the present moment, planer builders are sending out foundation drawings for their planers showing long and strong anchor bolts. These drawings convey the impression that there is a perverted tendency on the part of the planer to leave the foundations and travel skyward with the danger of tearing a hole through the roof of the building. Of course what I have just said is intended as a pleasantry, but seriously, have we not spent a great deal of time, and valuable brains over our foundation drawings for planers, and also has not a great deal of money been wasted when making these foundations, and supplying these monstrous bolts? For it is evident to me, after an experience of some twenty years, that no planer will ever attempt to leave the foundation on a vertical line. I believe it is true, however, with the ordinary brick foundation, or even a cement foundation, when the planer is lined up with wedges, that the bearing contact is so frail that the planer will move endwise, and gradually creep away from its original position.

We can all readily understand that, however elaborate the foundation, were the planers placed on balls, they would move very rapidly in the direction of the traverse of a return stroke, and somewhat in the direction of the forward stroke, depending, of course, upon the size of the balls. Now let us place under the planer very small balls; imagine them, if you please, to be about 1/32 inch diameter. We would then have a condition, not so very different from what we really have in many cases. Very few there are who use a wedge that is even planed. The planer resting on some minute particle of steel is very easily rolled from its position by the forces of the table. Underneath the wedge also, there is contact usually with very small particles of brick, stone or cement; these roll like balls, and we not only have a movement of the planer on the foundation, but the alinement of the ways is also destroyed.

If we can have a frank discussion of this question, I believe the result will be that there will be more planers placed on proper foundations, and that all of us will be benefited by better work from our planers and less expense of production.

This leads to another question I would like to put to the readers of this paper, i.e., how many planers in the United States are first made really straight, and how many are placed straight on their foundations, even though for a short period?

For many years I was in the habit of thinking of a planer as a machine that produced straight lines, but later experience has made me wonder why I did not see the errors produced by the planers that I had such implicit faith in, and I am wondering now how many there are that really know whether their planers plane straight or not.

I was astonished a few years ago to see a planer maker using a fish-line stretched along the ways of his planer to prove to me that the planer was straight. This incident revealed to my mind the fact that we all have ideas of accuracy that we obtain from different points of view, and that these ideas we obtain of accuracy are only relative.

I have a feeling, based upon considerable experience, that if we, as American machine-tool builers, hold our reputation for world accuracy and economy in construction, we must use more precaution when placing such machines as planers, for it is probably true that the usual method of placing a planer on a foundation is costing us more than we can afford to spend, especially when it is wholly unnecessary.

If Mr. Eberhardt should try a foundation that really bore accurately with the same pressure under the various points of support, and these various points of support were of sufficient width to form a permanent durable contact over the entire surface of each, I suspect his planers would not move, even though nothing were done to provide for steady pins or bolts. However, the return speed he mentions is greater than that of the planers with which I have had experience.

To illustrate this point in regard to a

reasonably perfect contact between the surfaces of the planer and the support, let me recall an experience with some piercing dies and punches that were used in a powerful punching press. These dies had many holes in them for punching plates; the relation of these various holes should be maintained with considerable accuracy. The smoothness of the holes also was desirable. It was found very difficult to maintain these dies sharp, also to maintain the punches. It was discovered that this trouble was caused by the "creeping" of the die on the press bed. The size of the binding bolts had been increased from year to year, so had the length of the wrench with which the nuts were screwed in place; in fact it was considered necessary that two men should pull on these long wrenches, in order to screw the die tightly in place to prevent "creeping." It occurred to me that this "creeping" was made possible by very slight, and possibly microscopic imperfections of the two surfaces, accordingly the bed plate of the press was scraped very accurately to a surface plate. Great pains were taken to "pick up" the surface very fine. The under surface of the die plate was also scraped to fit this one in the same precise manner. When the die and punches were in place in the press, after this refinement of the surfaces, it was found that the die would not creep even though the nuts on the bolts were screwed down only with the fingers, and this condition lasted until the surfaces became dented by careless handling The bolts then had to be screwed again as tightly as ever.

If all our planers rested on reasonably wide surfaces at the various points of support, and these points of support bore on the planer with equal pressure, there would probably be no need for making any provision for the moving of the planer. In addition to this, if these points of support can be adjustable, we will all secure, not only better work, but in the end, our work will be less expensive

To return to the holding-down bolts that all planer makers still provide in their foundation drawings, when according to the usual plan, the planer is leveled up with wedges and pieces of shingles, let us imagine the usual condition where the bolts are screwed down hard in certain places to cause the planer to plane straight, for this is the usual procedure when bolts are used. I think no one will fail to see that where these bolts are tightest, the imperfect wedges, shingles and crumbling cement will give way first, allowing that point to become depressed more than the other points so that we have what is well known to us all; constant change of alinement of our planers, incurring as we all know, delays and expense, and this constantly, for we must needs level up our planer very often, to secure good work.

Mr. George is right in regard to many machine tools. My thought, however, was along the line of planers, although I might have said any machine tool. I can readily see that when a machine stands on four feet, and this machine is a frail construction, it is necessary to bolt it to the floor to keep it from traveling to other points in the shop, but such a machine as that, of course, can never be accurate, and I would prefer to consider self-contained machines in this discussion. Any machine not self-contained, I think, is not of the kind that modern American practice should perpetuate, for certainly the floor of the shop, in such cases, becomes an essential part of the machine. It would seem that modern designers should leave the shop floor out of their designs entirely, and not base any hopes of success from any help they can get from a shop floor.

It would seem that all must see that such an uncertain and changeable thing as a wooden floor should not be considered, or depended upon when designing a machine. For this reason I believe that in this discussion we should ignore all machines that are not sufficiently self-contained, and whose center of gravity is not sufficiently low to perform any work they are called upon to perform, without tipping over or "creeping" about the shop; unless possibly it be the case of a high-speed planer, where in some cases it may be necessary to provide against endwise motion, but even then, why should it be bolted down? We all have great numbers of machines in use, such as described by Mr. George, but is it not well to discuss these questions, and come to some understanding, that we may not continue to produce such machines? In the case of the shaper mentioned by Mr. Noel, I can see no reason why bolting to the floor is not as good a provision as could be made, for certainly there is nothing about such a machine to require any great accuracy, for certainly shapers are not used in these days for accurate work, and even if they were, the fact that the column of the shaper will yield to the shape of the floor when bolted down, without materially affecting such accuracy, would seem to make any other provision unnecessary. This same reasoning seems also to apply to drill presses. If our machine tools were made more self-contained, or rather if more of them were made self-contained and arranged to stand on three feet only, fewer foundations would be required than now, for certainly a well designed tool resting on three points only performs its work just as well on an ordinary wood floor, whether it be an upper story or a ground floor, and foundations for such machines are wholly unnecessary. It is only when we have such machines as planers, where it seems impracticable to build them with any deeper beds, at least impracticable to build them with beds sufficiently deep to make them self-contained, that we need to rely upon the foundation. And when we prepare such foundations, they should contain adjustable points of support, and these points of support should be made with the same degree of accuracy as any part of the planer, if we expect good results; and whether, as Mr. George says, shopowners and managers decry such things as absurdities or not, the fact remains that it is for the financial benefit of all that such things are done, if they are done rightly. C. H. Norton.

Worcester, Mass.

Cutting V-Threads from One Side —Spiral Flutes for Taps

There have been various articles in the American Machinist in regard to cutting V-threads with the compound rest set at an angle of 30 degrees, but they all refer to external threads. For internal threads the same trick holds good. Set your compound rest to 30 degrees the next time you have an internal V-thread to cut and try it; you will get quicker and better results.

Professor Sweet states at page 387 that it would be interesting to know how long the various contributors have been using this method of cutting threads. I have used this trick for cutting threads 20 years and the man that showed me how was 60 years old at that time. I do not know when he learned it. When doing work on a lathe I always set the compound rest at 30 degrees as there is another advantage in having it in this position. Should I have a shaft to fit between shoulders and find the shaft 1/32 inch too long, I simply advance the compound rest 1/16 inch and take off the 1/32 inch required. This ratio of 2 to 1 holds on an angle of 30 degrees.

In regard to cutting spiral flutes in taps, this idea has helped out when everything else failed. The metal to be tapped was copper, the tap 3/8 inch diameter with a right-hand V-thread 24 to the inch. The spiral was cut right-hand 15 degrees or 1 turn in 4½ inches.

Philadelphia, Penn. C. H. Erb.

Straightening Tracings

In reply to D. T. Fletcher's request on page 580, would say that I had a similar experience and got excellent results from running the tracings through a friction calender such as they use in a cotton-finishing mill. First clean the tracing and then let the man that operates the calender run them through. In 15 minutes he will straighten out all the tracings he has. Don't have the cylinder in friction too hot. Thomas Andrews.

Rockaway, N. J.

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Contents

PAGE

Joints and Fittings for High Pressure Air 633
Bevel-gear Planing Attachment for the Shaper 642
Molding a Three-parted Job in a Two-part Flask 644
Detailed Instructions for Machine-shop Methods 645
Straightening Hardened Tools 649
Measuring Dovetail Slides, Gibs and Vs 650
Hobbing Die Chasers 653
Practical Letters From Our Readers: Different Ways of Doing the Same Job....A Screw-slotting Fixture....Milling Attachment for Milling Featherways in Saw Collars....A Fly-cutter Arbor....Special Spring Vise Jaws....Cutting Oil Grooves on the Universal Milling Machine ....A Bar for Boring Spherical Seats....Knock-out Fixture for Drill Sockets....A Holder for Bar Tools ....Eraser for Higgins' Ink....654-659
Discussion of the Previous Question: A Kink in Hardening High-speed Steel....Machining Eccentric Sheaves ....Taps with Spiral Flutes....Training Married Men....Crosswise Holes Through Cylindrical Work....Hardening Methods....Bolting Down Planers....Cutting V Threads..661-663
A Sample Report in German Industrial Schools 664
New Tools and Machine-shop Appliances 666-668

A Sample Report on German Industrial Schools

We have in the recent past referred to the paucity of knowledge that exists regarding the work and methods of the much lauded German system of industrial schools. A great deal has been written about them, but of it all it is surprising how little there is that is tangible, or in the smallest degree helpful in the movement which is now fairly inaugurated here toward the establishment of a system of schools having similar aims.

We are led to these remarks by a pretentious paper entitled, "The Industrial Improvement Schools of Wuerttemberg," by Albert A. Snowden, which was recently published in the *Teachers' College Record,* of this city. We have here a handsomely printed octavo pamphlet of 72 pages, giving pretty much all of the information which one can ask for except the thing he wants, namely, detailed information about what trades the schools teach and how they teach them. We find facts and figures without limit regarding the origin, the rise, and the recent reorganization of these schools, their numbers, the number of their pupils, their cost, and their manner of administration and support, but regarding their teaching of the subjects which it is proposed to teach here, or their manner of training pupils for the trades, we find almost nothing, and indeed, most of what we do find regarding the work done would lead one to believe that their connection with the manufacturing industries of the country is remote and indirect, and that comparatively little attempt at the actual teaching of trades is attempted. If this impression gives a correct view of the actual schools, then they are far from being what we have been led to think, while if the impression is incorrect the author of the pamphlet has missed an opportunity to tell the things which everyone interested in this movement wants to know.

We find, for example, the following list of subjects taught in the women's-work schools: Industrial arithmetic, commercial arithmetic, geometry and geometrical computation, descriptive geometry, geometrical drawing, special technical drawing, free-hand drawing, theory of style and color, modeling and wood carving, engraving and chiseling, physics, chemistry, engineering, mother tongue, penmanship and orthography, stenography, industrial bookkeeping, commercial bookkeeping, exchange, French, English, Italian, politico-economic subjects, commercial geography and history, German literature, housekeeping materials and hygiene.

Again, of the industrial schools of Stuttgart we find the following list of subjects taught: Mechanical drawing, business forms, industrial arithmetic, elementary geometry, engineering, physics, electro technics, French, ornamental penmanship, industrial art, ornamentation and style, industrial bookkeeping, stenography, penmanship, civic instructions and industrial drawing.

In all of the courses we are struck by the preponderance of drawing which, while closely related to it, is not trade teaching. We are told in fact that "in the future, as in the past, drawing will be, by all odds, the most important subject taught in the industrial schools. In both industrial and commercial schools the other basic subjects will be: Arithmetic, German, bookkeeping."

There is certainly little about any of the courses of study of which details are given to suggest the teaching of trades as that term is used here, although they do, of course, imply the teaching of artistic handicraft. It is to schools of this general character that the great bulk of the pamphlet relates, although it would be unfair to give the impression that there is no reference to trade schools properly so-called, and which everyone here has in mind when discussing the subject. These schools are, however, dismissed with the barest mention and without any information of a useful kind.

Thus we are told of "special technical courses for the separate trades and industries," and of "special technical institutions for the textile industry, weaving, embroidery, watchmaking, electro technics and fine mechanics, and other industries, and special courses given by experts," and we find a page and a half devoted to a school for the weaving industry at Reutlingen, with its course of study given as spinning, weaving, operation and pattern designing. Again, we find reference to a school in Schwenningen which gives instruction in clock and watchmaking and electro-mechanical work; and to a school for the book-printing trade, one for the tanning industry and another for the working of precious metals, of which one is given a page and the others a bare paragraph each. Elsewhere we find a bare reference to courses of instruction in hand gilding, horse-collar making, interior decoration, shoemaking, cutting, graining, marbled binding, electrical and interior installation, cabinetmaking, bookbinding, tailoring and watchmaking.

These latter references look promising, and indicate that trades are really taught, but the information given is substantially confined to such statements as those which we have extracted, and if anyone can find therein anything sufficiently tangible to supply any sort of a guide or give any information regarding how these schools are conducted and what they really do, he can do better than we can.

Now that the National Society for the Promotion of Industrial Education has a commissioner, we suggest that it can do nothing better than to send him to Germany for a study of these schools. Nothing of value will ever be learned

about them until they are examined by someone who, like Mr. Alexander, can look at them through the eye of a manufacturer.

The Conservation of Our Natural Resources

An important meeting was held in the main auditorium of the Engineering Societies' building, of this city, April 14, for the discussion of the above subject, which is now occupying such a large share of public attention. This meeting was held at the suggestion of President Roosevelt, and it was opened by the reading of his letter to the society in which the meeting was suggested.

The meeting was presided over by J. W. Lieb, who introduced the first speaker, Dr. W. J. McGee, chief of the Bureau of Soils and Secretary of the Inland Waterways Commission, Washington, D. C. Dr. McGee addressed the meeting on the conservation of the waters and woods, his remarks being illustrated by a series of lantern slides showing the effects of wholesale forest destruction, as well as some examples of the effects of reforestation. He gave a striking picture of the tremendous rate at which our natural resources are being consumed, saying that during the year 1906, 1200 pounds of high-grade iron ore were taken from the earth for every man, woman and child in the United States. He gave many illustrations of the effects of forest destruction on the flow of streams and springs and counter illustrations of the results following reforestation in the various countries of Europe.

Dr. McGee was followed by Dr. W. F. M. Goss, of the University of Illinois, who discussed the conservation of the nation's fuel supply. He began by pointing out that no nation can be really great without an adequate supply of fuel, and gave a few figures to show the rapid increase in the consumption of our coal, natural gas and oil. He also pointed out the tremendous waste due to present methods of mining coal, saying that approximately 50 per cent. of the coal under ground never gets to the surface. There has been comparatively little waste of our mineral-oil resources, but of natural gas the waste has been tremendous. In Indiana fuel gas sufficient for generations was squandered in two decades. He considered that the ownership of such public coal lands as still remain should continue with the Government.

Following Dr. Goss came Dr. G. F. Swain, of the Massachusetts Institute of Technology, who discussed the conservation of stream flow, water power and navigation, and especially the preservation of stream flow by the preservation of forests. Although he stated that the popular belief in an increase in the rainfall from increased area of forests has never been proven, the effect of the forests being to preserve the regularity rather than the total flow of the streams, this regularity, he pointed out, is the essential thing in connection with the use of the streams for power and navigation. He made plain the fact that the most valuable land for forests is the least valuable for agriculture, and expressed his conviction that this subject of the conservation of natural resources is one in which the engineer should and must lead public opinion.

Dr. Swain was followed by Dr. H. S. Pritchett, president of the Carnegie Foundation, who discussed the relation of the engineer to the body politic. He pointed out the growth of engineering from an occupation to a profession, and enlarged upon the duties of a profession to the public and the country. Great engineering works are not the product of recent times, but the progress of engineering has been accompanied by an increased sense of the obligation of engineers to the public welfare.

Spring Meeting of the A. S. M. E.

The Semi-Annual Meeting of the American Society of Mechanical Engineers will be held in Detroit, Michigan, June 23-26. Among the papers to be presented at this session are "A Method of Cleaning Gas Conduits," by W. D. Mount; "A Method of Checking Conical Pistons for Stress," by Prof. George H. Shepard; "Clutches" with special reference to automobile clutches, by H. Souther; "Horse-Power, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. L. S. Marks; "Some Pitot Tube Studies," by Prof. W. D. Gregory; "The Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck; "A Journal Friction Measuring Machine," by Henry Hess; "A By-Product Coke Oven," by W. H. Blauvelt; "Tests of Some High Speed Steam Engines," by F. W. Dean. There will be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the Promotion of Engineering Education and the Society of Automobile Engineers will also hold their annual meeting in Detroit at this time, which will enable members of each society to participate in the sessions of the other.

New Publications

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS. By a Staff of Specialists. 1284 4x6¾-inch pages, and some 1300 numbered illustrations. McGraw Publishing Company, New York City. Price, $4 net.

The first striking feature in this new handbook is its methods of treatment. The vast field of electrical engineering has been divided into 20 sections, each of which, complete in itself, forms one of the units of the book. The preface states that each section has been handled by a specialist. We find that one author wrote seven of the 20 sections and collaborated on three others. Two other sections were written by the same man, and no one stands as sponsor for sections 19 and 20, which deal with Standardization Rules, and Tables and Statistics. Our idea of an engineering handbook has been a work compiled from the field which it is to cover and giving a collection of practical rules, data and information, arranged in a usable and compact form. In connection with this practical information there should be a limited amount of condensed theory, sufficient to intelligently point the way for the use of the practical data. Our ideas have been fostered by an acquaintance with the best handbooks in the electrical-, mechanical- and civil-engineering fields. We find, however, that the needs of the electrical-engineering field are not met by a handbook in line with our preconceived notions; at least if we judge by the new standard now before us. The electrical engineer needs a handbook in the nature of an encyclopedia of fundamental theories and principles rather than a compilation of useful information. We had supposed that an electric handbook was for the electrical engineer in the construction and operating field rather than in the field of design. Designing engineers are fully as conversant with the advances along theoretical lines as are the writers of technical literature. Such men do not need a handbook to present theory. The operating and constructing engineer needs practical and usable data. Touching upon a few sections of the work: That dealing with materials used in electrical engineering is all that such a section should be. The publisher's note says that there is nothing new in this section. It is possible that this fact is one of the reasons for its appropriateness. There are other scattered bits of data which seem very desirable in such a work. Among these are some of the tables in the sections devoted to transmission and distribution, electric traction and electrochemistry. The data in regard to costs which are scattered through the work are commendable, as is also the section devoted to standardization rules. The section on tables and statistics seems very much abridged, occupying only 18 pages. That part of the section on miscellaneous applications dealing with the power requirements of machine tools is by no means in keeping with recent published data. The work seems to be an effort to condense the theories of electrical engineering into one small volume supplemented by as much practical information as the size of the work will allow. The library of the electrical engineer should contain all of this theoretical matter in standard publications in a more satisfactory form. However, the work will undoubtedly make an interesting addition to the library of the electrical engineer.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

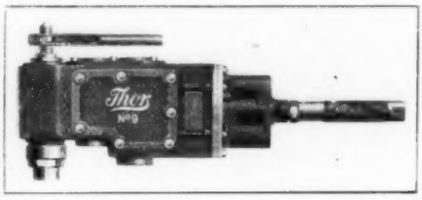
THE LATEST INFORMATION

Air Drill for Close Quarters

Air drills although particularly useful in repair work are sometimes out of the question on account of being unable to get into close quarters, such as inside corners of locomotive frames and similar places. In order to meet these requirements, the Independent Pneumatic Tool Company, Chicago, Ill., has designed an air drill especially for this kind of work and is making it in two sizes, known as "Thor" Nos. 8 and 9.

As will be seen, the spindle is at the extreme end of the tool and the motor consists of two parallel cylinders at right angle to the spindle. These are double-acting cylinders operating on a two-throw crank with the eccentric in the center for operating the valves which lie between the two cylinders. The crank-shaft proper is another two-throw crank in exactly opposite position. This crank operates direct on two oscillating levers centered on the drill spindle and having their bearings around it. These levers are provided with pawls which operate on ratchet teeth sunk in the spindle itself.

The lever-operating crank is arranged to have its power stroke on the part of the revolution farthest away from the spindle so as to make the speed of the lever more uniform, and pulls it forward considerably more than half its revolutions but returns it quickly. As the cranks are opposed the motion of the two



AIR DRILL FOR CLOSE QUARTERS

ratchets gives a continuous movement to the drill spindle. The engine cranks are set at an angle of 135 degrees so as to allow both pistons to pull when the position of the levers requires the greatest power.

The compactness of this drill is shown by the fact that the distance from the outside of the case to the throttle connection is 15⅜ inches, the distance from the point of the feed screw to the end of the drill socket is 8⅞ inches and it can drill a hole whose center is only 1 9/32 inches from the end of the case. The case itself is only 6¼ inches at the spindle and the whole machine weighs but 31 pounds. It has a maximum speed of 122 revolutions per minute.

Duplex Blueprinting Machine

Blueprints have come to be such a necessity in modern manufacturing and are used in such numbers that speed becomes of prime importance in selecting an equipment for this purpose. With this in view the designers of the "Tec" machine shown herewith have made it possible to do continuous printing in any length, and to be running two full-width strips through at once or as many smaller ones as can be accommodated.

The printing is done through the two curved glass plates *A A*, 24 by 56 inches each, with two vacuum lamps of the Cooper-Hewitt type between them at *B B*. Next to each plate and in contact with it, are 25 rubber bands with ⅛-inch air space between them to allow air to es-

FIG. 1. DUPLEX BLUEPRINTING MACHINE

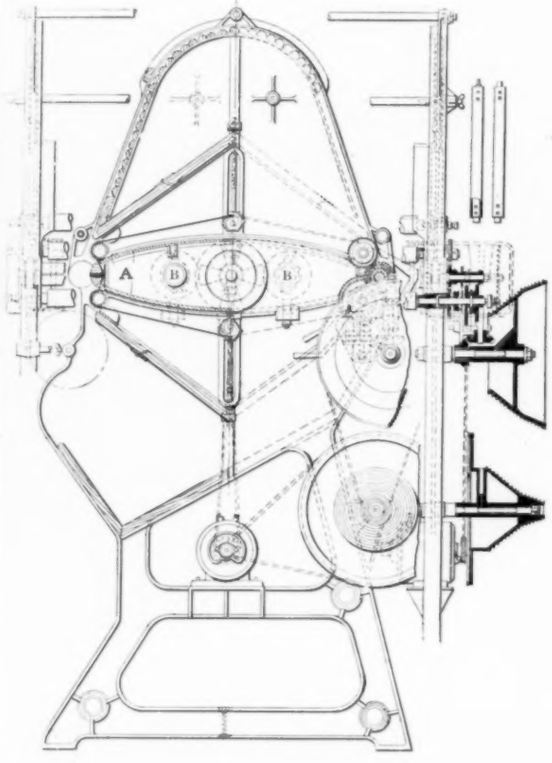


FIG. 2. DETAILS OF THE CONSTRUCTION

cape and to help keep the paper flat and the paper and tracings are fed between these bands and the glass so as to pass over the light.

The upper and lower bands have independent drives which allow a rapid printing paper to be used on one and slower print such as a Vandyke or a black print to be printing on the other at the same time, varying from a very slow rate up to 4 and 5 feet per minute for quick-printing paper. The feed gears can be changed by simply throwing a lever so that prints be fed through in either direction desired.

The whole upper frame swings back out of the way on a pivot so that the glass in both frames and the lamps can be cleaned, and it also allows the prints to be examined as they go through to see that everything is going smoothly.

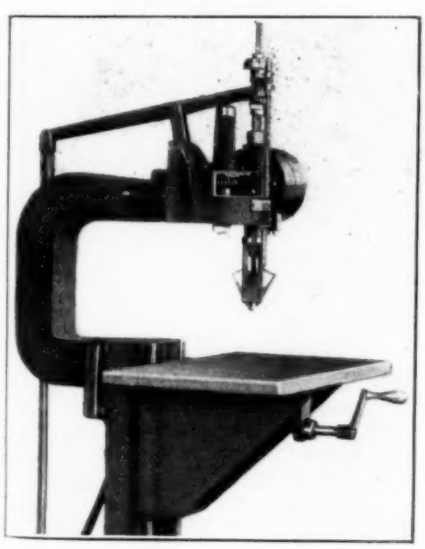
The ends of the machine are closed, except for ventilation and an exhaust fan provided so that the air is drawn uniformly over the glass and the lamps to keep them at an even temperature and avoid cracking.

The two views will show the operation quite clearly and leave no room to doubt the compactness or the capacity of the machine.

This is known as the "Tec" Duplex Electric Blueprinting machine and is made by the Technical Supply Company, 46 East Fourteenth street, New York.

Screw-driving Machine with a Gap Frame

To meet the demand for a screw-driving machine which could handle wide,

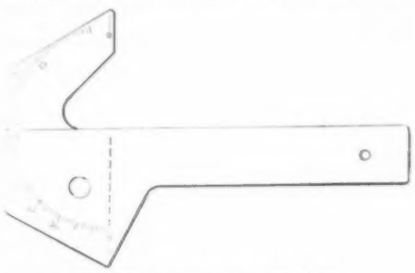


SCREW-DRIVING MACHINE WITH GAP FRAME

flat work to better advantage, the Reynolds Machine Company, Rock Island, Ill., has brought out the design shown with this. This differs from the regular machine shown on page 993, Vol. 30, Part 2, in having the main column cut off at the upper end of the tableways and a gap-extension frame added as shown. The magazine, friction-driven spindle, table and other details are the same as on the regular machines.

Draftsman's Protractor

Draftsmen who have much laying out to do, such as cams or lever mechanism, small hexagons or squares with vertical diagonals, will find this very handy, as it



PROTRACTOR FOR DRAFTSMAN

can be used against a T-square so as to get angles in increments of 15 degrees without measuring at all. This is very handy for many purposes as, though not exact, it is often used for laying out rack and worm teeth.

It has the usual degree workings of the ordinary protractor, and as the whole thing is of celluloid, the scored lines enable it to be quickly placed in any desired position. It is made by D. J. Kelsey, 77 Livingston street, New Haven, Conn.

Vicissitudes of the Job Shop

By J. G. Dornbirer

During the natural-gas boom in '88, three dry-goods merchants and a lawyer decided to go into a manufacturing business. They chose wood-pulp making as the most promising venture. It was a good field; quaking asp and buckeye grew close by in large quantities. An unlimited supply of natural gas could be had by boring to a depth of about 600 feet, and artesian water at about 200 feet. Land was given to all who were willing to build a factory thereon. In fact, the conditions for manufacturing wood pulp were ideal for anyone having knowledge of the art, but selling dry goods and pettifogging isn't making wood pulp.

Well, they hired a man, whose only experience with machinery had been to fire an engine on a road called the "narrer gage," to set up the machinery and arrange the mill to the best advantage. An old barn-builder built the building; an expert's advice would have cost too much. The mill was set on 12-inch cedar posts about 15 feet apart and about 18 inches above the ground. Two engines of 250 horse-power each had a fairly good foundation, including the outboard bearings.

The shafts on which the stones were mounted extended in opposite directions about 70 feet. The engines were right and left, of the tangye-bed type. These shafts were about 7 inches in diameter and connected with clamp couplings, except where connected on the engine shafts, where flange couplings were used.

These shafts with their heavy stones and frames were set upon a 3-inch plank floor, the pillow blocks were supported on 10x10-inch timbers.

I won't waste your time to relate how this construction acted on the couplings and engines; most smart apprentices will know.

The boiler house was built about 100 feet from the main building, with a 12-inch steam pipe leading over to the engines, with no protection other than a box of 1-inch boards loosely nailed around it. The result was that at times more water than steam came over. The engines were piston-valve engines; I will leave you to guess the rest; you needn't be good at guessing to guess what happened frequently.

The engines were started at 6 o'clock on Sunday evening and were intended to run until Saturday night at 12 o'clock; but there were daily shut-downs for repairs and troubles. This continued for about six years; the concern was unable to hold out any longer; it had wasted about $200,000.

Now 25 per cent. of the boss' patronage came from this mill. One day when he was in the mill he watched the railway fireman (who now had become superintendent) babbitting the main journal on the engine. He noticed that an attempt had been made to cut a spiral groove around the shaft, and also noticed that very little care was used to file off the bur raised by the chisel. There were, however, ample provisions made by the builder for lubrication without the spiral groove. The superintendent said the engine always ran hot and always needed water on the bearing, so he piped it over from the pump and kept it running when the engine was going. Very often it had to be kept going when the engine was not running, so that it might soon be going.

The water from the artesian wells had quicksand in it; they knew it; the pumps showed it. Yet this railway fireman from the "narrer gage" used it to run into the bearings to keep them cool.

The boss also noticed that there was poured into the bearing about 50 per cent. more babbitt than was necessary to fill it if there was no leakage. The journal was about 10 inches in diameter by 18 inches long; there was no leakage on the floor.

Now the boss was just foolish enough to go over to the office and criticize the whole job, the superintendent and sundry other things. Then he went back to his shop. He no sooner got back when the

telephone rang; it was the lawyer who was connected with this enterprise who wanted him to come up to his office about 8 o'clock that evening. Well, the boss was there at the appointed time, all the members of the company were there waiting. The boss was not offered a chair. You see in small towns a factory owner is "it," while a little job-shop owner is considered zero with a minus sign before it. Well, the lawyer (a man of about 50 years of age) walked up and down in the office a few times, then stopped in front of the boss and looked at him in silence for about a minute, and then broke forth something like this: "Young man! it does not become you, neither from the standpoint of age, experience nor social standing, to criticize any of the acts or methods pursued in operating an institution, the size of which and the intricacies of which are so completely out of the sphere of your mental capacities."

Well, he kept this tirade up until the boss was so bewildered that he did not know whether this pettifogger was swearing at him, or pronouncing a benediction. Then one of the dry goods men got up and said that his bills for repairs were an outrage, that the boss was not justified in charging 50 cents per hour, since they paid their superintendent, a man of infinitely more ability, only 25 cents per hour. He added that their work would in the future go to his competitor. The boss didn't seem to care much, since he said that each month when the bill was presented he had to explain each item, and finally deduct from 10 to 20 per cent. before the bill was paid.

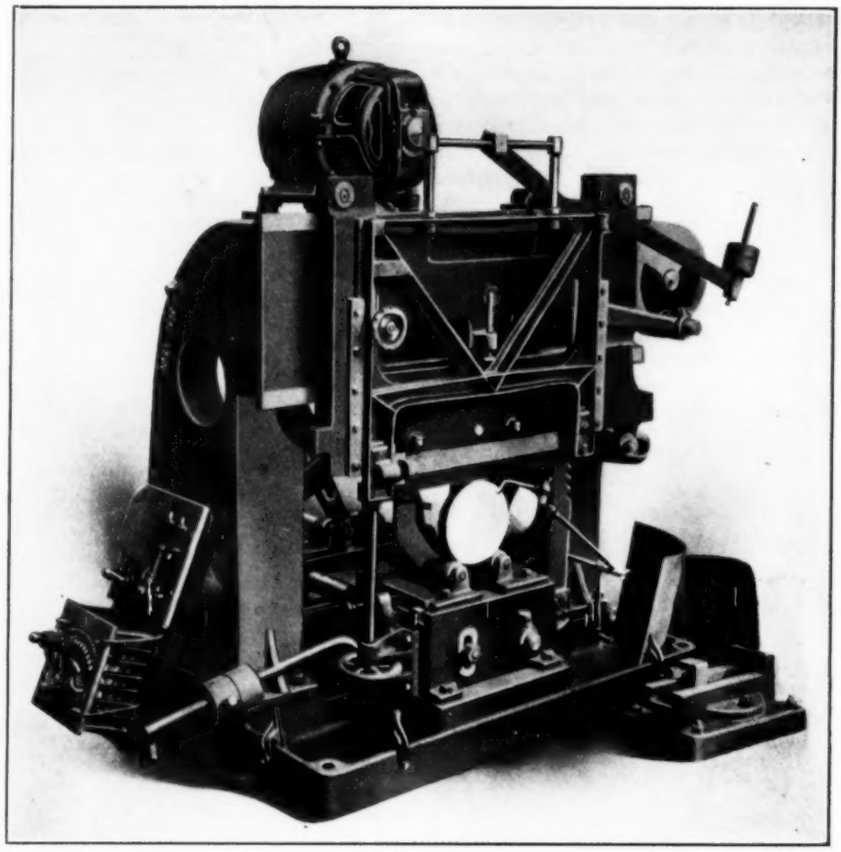
Now the boss and his competitor had a working agreement; in the presence of others they were bitter enemies. The competitor was an old man and would stand for no monkeying, so the pulp company soon brought back their work. But the boss was different; he learned fast; from that time on necessary provisions were made on each item in anticipation of the customary reduction on the bills. If the treasurer happened to be in a good mood the discount would not be so great, but since the boss assumed that the treasurer was always in a bad mood, it frequently so happened that the boss was the gainer.

Well, after this concern went out of business the boss paid them $100 for the privilege of gathering up all of the odds and ends around the place. Among these odds and ends were about 2800 pounds of connecting-rod brasses, valves and pump rods. The boss also remembered the leakage when the main journal on one of the engines was babbitted, and examined things carefully where the engine stood. Then he went outside and crawled under the building. He soon came out, got a block and tackle, hitched it to a mass which he found and with the aid of a horse pulled out a slab of babbitt weighing over 2200 pounds; and *genuine* babbitt at that. There must have been a blowhole in the casting which led down between the post supporting the roof and the engine frame, since we found a sort of burnt hole in the floor at that point. The babbitt must have leaked out at about the moment the bearing was full, or the failure to fill would have shown it. It certainly was a harvest and leads us to believe more strongly that "all things come to him who waits."

An English Hack-sawing Machine

By Frank C. Perkins

The accompanying illustration shows a unique hack-sawing machine of English design, constructed at Milnrow, the power being supplied by a motor mounted on the top of the machine. This machine cuts off circular blanks and tubes from 5 inches to 10 inches in diameter and may be utilized also for sawing off bars and beams 6 inches to 10 inches.



AN ENGLISH POWER HACK SAW

The machine consists of a strong base plate upon which are mounted two uprights carrying the cross rail on which is the reciprocating slide carrying the saw. The saw frame is balanced and has a gravity feed which may be adjusted by moving the balance weight along the lever. The frame is guided in slides at both sides. A stop is provided to prevent the saw frame from falling after having cut through the bar.

The saw frame is moved along the cross rail by the connecting rod and crank, and runs on rollers to eliminate the friction, the bottom rollers have vertical adjustment to take up wear. The driving wheel runs 220 revolutions per minute, the driving gear being carried on two brackets bolted to the right-hand shaft through 5 to 1 spur gearing. The bar is intermittently rotated against the saw by H. Liebert's patent revolving device which keeps the saw always cutting on the edge of a circle and enables blanks to be cut off when the saw reaches the center.

The machine weighs over 3000 pounds and uses 2½ horse-power. It is supplied with stand on which is mounted a roller slide for supporting the outside ends of long bars and all necessary keys. The sectional guards are removed from the front and end of base to show the details. They are held in the clamp shown.

Only flaming arc and high-efficiency incandescent lamps are used in the business portions of Berlin, and 90 per cent. of all outdoor lighting is done by the former. Both tantalum and tungsten lamps are in use, but the former are seen usually in old fixtures, where the lamp cannot be placed vertically.

Business Items

The Pittsburg (Penn.) Automatic Vise and Tool Company has opened an office on Olive street, St. Louis, Mo. R. C. McCully is manager.

The New York office of Crocker-Wheeler Company, Ampere, N. J., will be moved on April 24 to the Cortlandt building, Hudson terminal, 32 Cortlandt street.

The executive offices of the Westinghouse Electric and Manufacturing Company, now at 111 Broadway, New York, and the New York sales and export offices, of that company now at 11 Pine street, will be removed on Monday, April 20, 1908, to the new City Investing building, 165 Broadway, New York.

The Hanna Engineering Company, Chicago, Ill., has acquired the line of pneumatic compression riveters, formerly manufactured by Quincy, Manchester, Sargent & Co., Plainfield, N. J. The latter company will devote its attention to the manufacture of metal-sawing machines, car steps, cranes and hoists.

The name of the General Pneumatic Tool Company, Montour Falls, N. Y., makers of electric cranes and hoists, will be changed on May 18 to Shepard Electric Crane and Hoist Company, in order to harmonize the name with the product. The New York office of this company will be moved on April 22 from Singer building to the Fulton building, Hudson Terminal.

On page 631 it was incorrectly stated that the warehouse of J. J. McCabe, 14 Dey street, New York, had been moved. The offices of this company will be moved on May 1 to the Hudson Terminal building, 30 Church street, New York. Showrooms will be moved to the present warehouse where the stock will be exhibited to much better advantage than heretofore.

Trade Catalogs

International Steam Pump Company, New York. Bulletin BK-811, illustrating and describing special vertical duplex piston pump.

Lodge & Shipley Machine Tool Company, Cincinnati, O. Catalog S describing engine lathes. Illustrated, 108 pages, 6x9 inches, paper.

Firth-Sterling Steel Company, Pittsburg, Penn. Catalog of Blue Chip high-speed steel and other tool steels. Illustrated, 64 pages, 3½x6½ inches, paper.

The Brown Hoisting Machinery Company, Cleveland, Ohio. Catalog describing "Ferroinclave" for roofing, siding, etc. Illustrated, 36 pages, 6x9 inches, paper.

Manufacturers

The Buick Motor Company, Flint, Mich., will build a three-story addition.

The Cincinnati (Ohio) Galvanizing Company will build an addition.

The Hobb's Glass Works, London, Ont., was destroyed by fire, causing a loss of nearly $300,000.

The American Brass Manufacturing Company, Cleveland, Ohio, will erect a foundry and machine shop.

The Caswell Cotton Mills, of Kinston, N. C., has started the construction of its plant.

The plant of the F. Wilder Lumber Mfg. Company, Epps, Miss., was destroyed by fire. Loss $125,000.

The Twitchell-Champlin Company of Portland, Me., will establish a canning factory at Lubec, Me.

The Valley Falls Company, Albion, R. I., manufacturing cotton goods, will build a new and larger mill.

The Maryland Steel Company is preparing to build an extension to its plant at Sparrows Point, Md.

The Conestoga Traction Company, Lancaster, Penn., has had plans prepared for car-repair shops.

The Bardwell (Ky.) Canning Company has been organized with $10,000 capital stock. A. T. Hobbs, president.

The Atlantic Canning Company, Machias, Me., has been organized with $50,000 capital stock. Everett I. White, president.

The Aldrich Manufacturing Company, Buffalo, N. Y., making copper and brass goods, will erect a six-story addition to its plant.

The Blanchard Construction Company, Topeka, Kan., is building a planing mill and factory to cost $15,000.

The British Columbia Electric Railway Company has let contract for the erection of additional car shops at New Westminster, B. C.

The Paragon Manufacturing Company, making washing machines, Chicago, Ill., will build a plant at a cost of $25,000.

The Foote Bros. Gear and Machine Company, Chicago, Ill., has let contract for a new three-story factory to cost $50,000.

S. C. Morgan, Northfield, Minn., has engaged in the machine shop business and would like catalogs of machine tools and other equipments.

The General Electric Company, Schenectady, N. Y., will commence erection of a foundry at Erie, Penn., for manufacturing special castings.

The Alma (Ark.) Canning Company, recently incorporated, will erect a $15,000 building and install machinery to cost $12,500.

The Foundry Investment Company, St. Louis, Mo., has awarded contract for the erection of an addition to foundry to cost $40,000.

The Waxahachie (Texas) Foundry and Machine Company has been incorporated with $10,000 capital stock. J. T. Andrews, president.

The A. J. Vollrath Company, Sheboygan, Wis., manufacturing pressed ware, has let contract for the construction of two new buildings.

The Connecticut Mill Supply Company, Torrington, Conn., is equipping a factory for the manufacture of steel rings used on spinning frames.

The San Diego & Arizona Railway Company is planning the erection of car shops and round houses at San Diego, Cal., to cost about $500,000.

It is reported that the American Locomotive Company, Schenectady, N. Y., is planning the erection of a shop for building freight cars at Glenville, N. Y.

The Reading Iron Company, Reading, Penn., will shortly start the erection of its new factory for the manufacture of the larger sizes of pipe.

The Marvel Street Hydrant and Novelty Company, Lindsay building, Montreal, Canada, will build a plant to manufacture a non-freezing hydrant.

It is stated that the Boston & Albany Railroad Company will soon erect a new roundhouse at its Rensselear, N. Y., yards. W. Shepard, Boston, chief engineer.

It is announced that the Delaware & Hudson Railroad Company intends to consolidate all its shops into one large plant to be located in Albany county, near Watervliet.

The Globe Manufacturing Company, Perry, Iowa, making washing machines, has purchased site for a new factory building. The output will be doubled.

M. de Calistock, director, School of Arts, Quito, Ecuador, would like catalogs with prices, discounts, etc., on lathes, machinists' tools, shoe-making machinery.

The Duluth, South Shore & Atlantic Railway has decided to erect a concrete roundhouse in the Houghton, Mich., yards, to replace the one recently burned.

The Sea Gull Specialty Company, of New Orleans, La., will establish a branch plant in New Orleans, for the manufacture of tin and paper cans and packing cases.

The Rigby-Frazier Company, of Norwalk, Ohio, and Martinsville, W. Va., manufacturing oil and gas well tools and supplies, will erect a plant in Newark, Ohio.

The Acme Engine Company, Spokane, Wash., will enlarge the capacity of its shops. A drop-forging plant and other modern machinery will be installed.

Hoopes & Wilson, Cœur D'Alene, Idaho, expect to equip their shop with wood-working machinery for the manufacture of office fixtures, furniture and interior trim.

It is announced that the United States Steel Corporation will soon begin construction of a large plant and model city on the Canadian river front below Sandwich.

It is reported that Chas. M. Schwab intends making improvements to the plant of the Union Iron Works, San Francisco, Cal., at a cost of approximately $600,000.

The Casterline Cutlery Company will enlarge its plant in San Diego, Cal., and move its main offices from Portland, Ore., to San Diego. New machinery will be installed.

The Coatesville (Penn.) Foundry and Machine Company has let contract for the construction of a plant to be equipped for the manufacture of boiler fronts, grate bars, etc.

The plant of the Western Paper Goods Company, Cincinnati, Ohio, was destroyed by fire. Loss about $175,000. The company manufactured folding paper boxes, envelopes and paper bags.

The Balderson Iron Company, Beloit, Wis., is now being incorporated and plans are being made for a large foundry in South Beloit. A. S. Balderson, South Beloit, is president.

The Hemsley Patent Adjustable Top and Tire Bolting Machine Company, Trenton, N. J., will erect a plant to manufacture tire bolting machine. Joseph Hemsley is interested.

The Capital Lock-nut and Washer Company, of Columbus, Ohio, will take over the plant of the Robertson Machinery Company at Welland, Ont., and will expend $100,000 in improvements.

The Pacific Malleable Castings Company, Riverside, Cal., has been organized with a capital stock of $500,000. Site for foundry has been purchased. J. Brent Harding, is secretary and treasurer.

H. L. Pague, president of the Pague Manufacturing Company, Kansas City, Mo., contemplates organizing a company to establish a plant in Houston, Tex., for manufacturing cans and galvanized ware.

The Forged Steel Wheel Company, of Butler, Penn., a branch of the Standard Steel Car Company has increased its capital stock and will spend about $500,000 in improving its plant at Lyndora, Penn.

The Ash Templet Company, St. Louis, Mo., has been incorporated with $50,000 capital to manufacture templets used in constructing steel buildings, etc. James D. Malin and Gus S. Kann, incorporators.

New plans, to replace those made some time ago, are now being prepared by the Mexican Central Railroad for the enlargement of its shops at Guadalajara. These will call for larger floor space and much new machinery.

The Oklahoma Implement Manufacturing Company, Oklahoma City, Okla., recently incorporated with $150,000 capital stock, is having plans prepared for a foundry building. D. W. Lackey is one of the incorporators.

The National Compressed Air Power Company, Montgomery, Ala., a new concern with $200,000 capital, will erect a factory for building compressed-air engines for power purposes. Offices are in the First National Bank building.

The P. O. Adams Rail and Safety Appliance Company, has been incorporated with $100,000 capital for the purpose of manufacturing safety rail joints, frog railroad crossing, etc. Incorporators, P. O. Adams, Dr. J. C. Reese and others.

Work will soon commence on the new plant for the Warrenton Woolen Company at Torrington, Conn. This will include a main factory, dye house, store house and repair shop and boiler and engine house. Chas. T. Main, 45 Milk street, Boston, Mass., is engineer.

The Rome & Osceola Railroad Company has been incorporated with $500,000 capital to construct a standard gage railroad from Rome to Osceola, N. Y., to be operated by either steam or electric power. J. S. Haselton, of Rome, N. Y., W. P. White and W. I. Taber of Utica are among the incorporators.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Model making. Patented machines manufactured on royalty. Rotary File & Machine Co., 589 Kent Ave., Brooklyn, N. Y.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

If you have a copy of March 7, 1907 AMERICAN MACHINIST we'll give you fifteen cents for it. AMERICAN MACHINIST, 505 Pearl St., New York.

Wanted—Machinist with good ideas to take an interest in fine tool business. Good opportunity to progressive man. E. G. Smith Co., Columbia, Pa.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia.

Wanted—Shaper, about 20" stroke. Vertical power feed to head. Must be in good condition and a bargain. Box 29, AM. MACH.

Harden tool steel like diamond, tough inside, no cracks, burns or warps, cool in pure water. Sample can prepaid, 24c. King Steel Co., 4224 Perry St., Chicago.

Gears cut to order, bevel, spur and miter, on Bilgram and Gleason machines. Complete gears furnished. The Cincinnati Gear Works, Murdock Bldg., Cincinnati, Ohio.

Factory superintendents, foremen, draftsmen, cannot afford to miss our slide rule course. For particulars write Box 455, or The Mechanics Correspondence School, Lockport, N. Y.

Mail your invention for free opinion and how to patent and profit without expense to you. E. P. Thompson, M. E., member A. S. M. E., A. I. E. E., etc., 53 West Morningside Ave., New York City.

We want live men in every factory or shop to make money in spare time by selling Manipure, the new cleaner for greasy hands. Send five cents for sample and particulars. Reliance Supply Co., Camden, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Machinists take notice. Purchase castings and blue prints of high grade gasolene motor, of world-wide reputation and at a profitable business. Write today. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

British patent rules, 1908. We can produce light fine engineering and mechanical specialties and tools, accuracy and finish guaranteed. Model Manufacturing Co., 52 Addison Road North, Holland Park, London.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Foreman toolmaker with technical education and extensive experience on special machinery, tools and fixtures for interchangeable manufacture wants similar work. Box 70, AMERICAN MACHINIST.

MASSACHUSETTS

First-class metal patternmaker, experienced on hand and molding-machine patterns, wishes position. Will go anywhere. Box 938, AMERICAN MACHINIST.

Wanted—Position as designing draftsman by a Swedish technical graduate, 27 years of age, with three years' experience in United States. Box 59, AMERICAN MACHINIST.

Wanted—Position by first-class mechanical man, who is a mechanical engineer, expert designer of jigs and tools, A-1 draftsman, familiar with office work and accounts; as assistant manager, superintendent or purchasing agent; at present employed, but wish to make change; first-class references as to character and ability. Box 69, AMER. MACH.

NEW JERSEY

Foreman toolmaker, long experience in designing and constructing of dies, jigs and special fixtures of any description, desires change. Box 46, AMERICAN MACHINIST.

A-1 machinist and toolmaker, twelve years executive. Modern, systematic, thorough and competent in directing any class of manufacturing, toolmaking or machine work. Highest references. Box 41, AMERICAN MACHINIST.

NEW YORK

Tool and die maker with good experience; also designer of special tools. Box 62, AMERICAN MACHINIST.

Mechanic with 15 years' experience in machine shop toolroom and drawing room; good references. Box 63, AMERICAN MACHINIST.

Mechanical engineer, young man, unexperienced, I. C. S. graduate; desires position at anything; wages no object. Box 67, AM. M.

Mechanical draftsman; 24; wishes position; 5 years' broad experience in automatic and general machine line. Box 65, AM. M.

Gas engine designer and draftsman, married, with broad experience wishes a steady position with chance for advancement. Box 56, AMERICAN MACHINIST.

Position as superintendent or factory manager by practical mechanic at salary of not less than $4,000. Can buy interest in good prospect. Box 34, AMERICAN MACHINIST.

American, 32, desires position as superintendent or master mechanic in metal goods or light machine manufacturing; high-class references. Box 68, AMERICAN MACHINIST.

All around mechanic, designer of special machinery and equipment, efficient manager of help, desires responsible position, salary $2500. Will go anywhere. Box 42, AM. M.

Machinist, toolmaker, experienced foreman, expert all branches, excellent on special dies, jigs, special devices, wants position; highest references. "L. M.," 133 W. 113th St., New York City.

Inventor and engineer; highest standing as developer and designer of machinery; man of business and character; with one concern past 10 years; wants position. Box 54, AMERICAN MACHINIST.

Mechanical engineer, gas engine expert, college graduate, with extensive experience here and abroad, wants position as superintendent, chief draftsman, representative or salesman. Box 45, AMERICAN MACHINIST.

Gas engineer, technical graduate; large experience in design, manufacture and installation of producers, gas engines and electric plants; desires position with manufacturer or contracting engineer. Box 55, AM. MACH.

Mechanical engineer, college graduate wants position as assistant superintendent, chief or designing draftsman; experience in steam engineering, air compressors and pneumatic mining machinery; references A-1. Box 21, AMERICAN MACHINIST.

PENNSYLVANIA

Engineer, draftsman, mechanical, structural, 8 years. Box 71, AMERICAN MACHINIST.

Draftsman, mechanical and structural, college graduate wants position; salary $20 per week. Address Box 23, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Patternmaker familiar with fitting up wood patterns for molding machines. Address "Saunders," AMERICAN MACHINIST.

ILLINOIS

Wanted—A-1 factory manager. Must have a good knowledge of sheet metal business. We require a man with executive ability, one capable of organizing and handling men to the best advantage. Must be practical and up-to-date. Plant is located in Illinois. Give full account of past experience. Correspondence confidential. Box 31, AMER. MACHINIST.

MARYLAND

Wanted—Experienced draftsmen on general heavy machinery. Address Ellicott Machine Co., Batimore, Md.

MISSOURI

Wanted—Salesmen or office men familiar with tools and forgings to invest in treasury stock of tool plant; 25 per cent. or better on investment and positions to qualified men. Address "Beasley," 425 Bates St., St. Louis, Mo.

NEW JERSEY

Wanted—Writer to prepare mechanical engineering articles during spare time; state experience. Box 60, AMERICAN MACHINIST.

NEW YORK

Wanted—A draftsman who can estimate cost and lay out sheet brass work from blueprints and sketches; a permanent position at reasonable salary for the right man. Box 66, AM. M.

Foreman wanted machine department large factory. Requirements are knowledge of drill press, lathe, screw and milling machines, experience in interchangeable manufacturing, ability to handle men, systematize and get out large variety of standard work. Box 26, AMERICAN MACHINIST.

Wanted—A mechanical draftsman for instrument work; a practical experienced man who can, if necessary, build and assemble what he designs; a man who can work out the details and carry an idea along to mechanical completion; salary according to ability; state experience fully and salary desired. "Mechanical," AMERICAN MACHINIST.

Wanted—A thorough mechanic with practical experience in the manufacture of small interchangeable parts; capable of determining machine capacities, proper tools, conditions, etc., to obtain maximum efficiency for piece rating; a man with experience in gun manufacture preferred. Address "Superintendent," Box 57, AMERICAN MACHINIST.

Wanted—First-class toolmaker who has had several years' experience in watch factory toolroom on master plates and sub-press die work, also experience in the manufacture of watch factory and precision tools. When replying give experience in full and state with what firms you have been employed, how long with each and on what class of work; also give age and salary expected. Box 61, AMERICAN MACHINIST.

OHIO

We want an experienced wood working machinery designer. Address giving references and experience. Box 20, AMER. MACH.

A concern in the middle west building dies, punch presses and drop hammers, needs a traveling salesman; applicant should be able to figure on blanking, forming and embossing dies; give references and state salary. Box 17, AMERICAN MACHINIST.

Wanted—By large concern in Middle States four first-class lathe hands, men capable of handling from two to six men and boys and teaching them to do good and rapid lathe work. Applicants will have good opportunity to travel as lathe demonstrators. In writing give past five years' experience. Box 33, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—First class draftsman on mill construction and equipment, technical man preferred. Box 24, AMERICAN MACHINIST.

VIRGINIA

Wanted in manufacturing industry in Virginia, high-grade man for mechanical superintendent; must understand cost keeping and business system; give references and state salary expected. Box 64, AMER. MACHINIST.

For Sale

For Sale—One Hewes & Phillips corliss engine, 18x36, 160 H.P., with pulleys and countershaft. Hanan & Son, Front and Bridge Streets, Brooklyn, N. Y.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co.	94
Acme Machinery Co.	62
Adams Co.	66
Albro-Clem Elevator Co.	91
Almond Mfg. Co., T. R.	80
Alteneder & Son, Theo.	79
American Emery Wheel Wks.	94
American Gas Furnace Co.	77
American Pulley Co.	79
American Tool and Mach. Co.	68
American Tool Works Co., 8 and	96
American Tube & Stamping Co.	101
American Watch Tool Co.	67
American Wood Working Machinery Co.	68
Armstrong Blum Mfg. Co.	76
Armstrong Bros. Tool Co.	45
Automatic Machine Co.	73
Baker Bros.	77
Baldwin Chain & Mfg. Co.	75
Bardons & Oliver	69
Barnes Co., W. F. & John	14
Barnett, G. & H.	36
Bath Grinder Co., Inc.	57
Baush Machine Tool Co.	3d cover
Bay State Stamping Co.	93
Beaman & Smith	15 and 80
Becker-Brainard Milling Machine Co.	23
Bemis & Call Hardware & Tool Co.	68
Besly & Co., Charles H.	67
Bethlehem Foundry and Machine Co.	69
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	98
Bilgram, Hugo	91
Billings & Spencer Co.	84
Blaisdell Machinery Co.	93
Blanchard Machine Co.	71
Bliss Co., E. W.	25
Blount Co., J. G.	94
Boston Gear Works	90
Boston Saw and Tool Co.	74
Bowsher Co., N. P.	74
Boynton & Plummer	74
Bradley & Son, C. C.	68
Bradford Machine Tool Co.	5
Bristol Co.	4th cover
Brown & Co., R. H.	80
Brown & Sharpe Mfg. Co.,	4th cover
Brown Hoisting Mchry. Co.	78
Brubaker & Bros., W. L.	74
Bullard Mach. Tool Co.	35
Burke Electric Co.	88
C & C Electric Co.	87
Caldwell & Son Co., H. W.	102
Cammel, Laird & Co.	83
Carborundum Co.	6
Card Mfg. Co., S. W.	16
Carpenter Steel Co.	82
Carpenter Tap & Die Co., J. M.	71
Case Mfg. Co.	78
Cell Drier Machine Co.	83
Chambersburg Engineering Co.	70
Champion Tool Works Co.	76
Chicago Flexible Shaft Co.	60
Chicago Raw Hide Mfg. Co.	88
C. I. F. Co.	65
Cincinnati Elec. Tool Co.	88
Cincinnati Lathe & Tool Co.	75
Cincinnati Machine Tool Co.	24
Cincinnati Milling Machine Co.	7
Cincinnati Planer Co.	24
Cincinnati Shaper Co.	102
Clark Cast Steel Cement Co.	83
Claye & Sons	88
Clayton Air Compressor Wks.	93
Cleveland Auto. Mach. Co.	18
Cleveland Cap Screw Co.	76
Cleveland Crane & Car Co.	78
Cleveland Planer Works	74
Cleveland Twist Drill Co.,	4th cover
Cleveland Wire Spring Co.	71
Clough, R. M.	91
Clum & Atkinson	83
Coates Clipper Mfg. Co.	92
Coes Wrench Co.	14
Colburn Machine Tool Co.	26
Cock Co., Asa S.	76
Consolidated Press and Tool Co.	68
Crescent Forgings Co.	72
Crocker-Wheeler Co.	88
Crosby Steam Gage & Valve Co.	17
Curtis & Co. Mfg. Co.	92
Curtis & Curtis Co.	76
Cushman Chuck Co.	80
Davis Machine Co., W. P.	98
Desmond-Stephan Mfg. Co.	95
Detrick & Harvey Mach. Co.	76
Diamond Chain & Mfg. Co.	75
Diamond Machine Co.	36
Diamond Saw and Stamping Works	71
Dickinson, Thos. L.	36
Dill Slotter People	70
Dixon Crucible Co., Jos.	72
Dodge & Day	1
Dreses Machine Tool Co.	9
Earle Gear & Mach. Co.	91
Eastern Machinery Co.	74
Eberhardt Bros. Mach. Co.	91
Eck Dynamo and Motor Co.	88
Elmes Engineering Works, Chas. F.	75
Emmert Mfg. Co.	85
Errington, F. A.	81
Evans Friction Cone Co.	72
Excelsior Needle Co.	68
Farrel Fdry. & Machine Co.	83
Fawcus Machine Co.	90
Fay Machine Tool Co.	59
Fellows Gear Shaper Co.	49
Ferracute Machine Co.	76
Firth-Sterling Steel Co.	84
Fitchburg Machine Works	29
Flather Planer Co., Mark	74
Foote-Burt Co., The	84
Fosdick Machine Tool Co.	16
Franklin Mfg. Co., H. H.	82
Franklin Portable Crane & Hoist Co.	79
Fulton Machine & Vise Co.	85
Gang Co., Wm. E.	74
Gardner Machine Co.	94
Garvin Machine Co.	43
Gem Mfg. Co.	93
General Electric Co.	86
General Pneumatic Tool Co.	79
Geometric Tool Co.	2a
Gisholt Machine Co.	100
Gleason Works	4th cover
Globe Mach. & Stamping Co.	75
Goldschmidt Thermit Co.	83
Gorton Machine Co., Geo.	71
Gould & Eberhardt	60
Graham Mfg. Co.	85
Grant Gear Wks.	90
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Gray Co., G. A.	28
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Greaves, Klusman & Co.	71
Grönkvist Drill Chuck Co.	80
Hammacher, Schlemmer Co.	53
Hardinge Bros.	74
Harrison & Knight Mfg. Co.	75
Harrington, Son & Co., Edw.	79
Hart & Cooley Co.	65
Hart Mfg. Co.	67
Hendey Machine Co.	51
Henry & Wright Mfg. Co.	65
High Duty Saw and Tool Co.	57
Hill, Clarke & Co., Inc.	97
Hill Publishing Co.	61, 95 and 99
Hisey-Wolf Machine Co.	25
Hoefer Mfg. Co.	64
Hoggson & Pettis Mfg. Co.	81
Horsburgh & Scott Co.	90
Horton & Son Co., E.	80
Hunt Co., Robt. W.	76
Hurlbut-Rogers Machine Co.	73
Independent Pneumatic Tool Co.	92
Ingersoll Milling Machine Co.	25
Ingersoll-Rand Co.	93
Jacobs Mfg. Co.	81
Jantz & Leist Elec. Co.	87
Johnson Machine Co., Carlyle	51
Jones & Lamson Mach. Co., 12, 13 and	36
Juengst & Sons, George	64
Kearney & Trecker Co.	72
Kelly Co., R. A.	72
Kempsmith Mfg. Co.	22
Kern Machine Tool Co.	63
Krieger Tool & Mfg. Co.	76
Landis Machine Co.	62
Landis Tool Co.	45
Lapointe Machine Tool Co.	68
Lea Equipment Co.	60
LeBlond Machine Tool Co., R. K.	4th cover
LeCount, Wm. G.	98
Link Belt Co.	73
Lodge & Shipley Machine Tool Co.	4
Long & Allstatter Co.	71
Lucas Mach. Tool Co.	100
Lumen Bearing Co.	82
Lunkenheimer Co.	77
Lyon Metallic Mfg. Co.	72
Machine Screw Products Co.	95
Manning, Maxwell & Moore, Inc.	78
Manufacturing Equipment and Engineering Co.	69
Manville Bros. Co.	17
Manville Machine Co., E. J.	63
Maris Bros.	78
Marshall & Huschart Mch. Co.	96
Massachusetts Saw Works	84
McCabe, J. J.	26 and 96
McInnes Steel Co.	83
Merritt, Jos.	76
Merritt & Co.	74
Metal Hardening Solution Co.	82
Milton Mfg. Co.	98
Miner & Peck Mfg. Co.	74
Mitts & Merrill	92
Monarch Emery & Cor. Wheel Co.	94
Moore Co., Franklin	78
Morse Chain Co.	64
Morse Twist Drill & Mach. Co.	47
Morton Mfg. Co.	75
Mossberg Wrench Co.	76
Motch & Merryweather Machine Co.	97
Mueller Mach. Tool Co.	69
Mumford Co., E. H.	76
Mummert, Wolf & Dixon Co.	62
Nash Co., Geo.	83
National Acme Mfg. Co.	102
National Machinery Co.	75
New Britain Mach. Co.	70
New Haven Mfg. Co.	73
New Process Raw Hide Co.	91
Newton Machine Tool Works, Inc.	11
Nicholson & Co., W. H.	60
Nicholson File Co.	17
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Nolte Brass Co.	75
Northern Electrical Mfg. Co	86
Northern Engineering Works	78
Norton Co.	59
Norton Grinding Co.	58
Nuttall Co., R. D.	90
Nutter & Barnes Co.	62
Obermayer Co., S.	83
O. K. Tool Holder Co.	76
Owen Machine Tool Co.	22
Page-Storms Drop Forge Co.	85
Parker Company, Chas.	85
Pawling & Harnischfeger	78
Paxson Co., J. W.	74
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Philadelphia Gear Works	90
Pittsburg Auto. Vise & Tool Co., Ltd	85
Potter & Johnston Mach. Co., 20 and	21
Powell Tool Co.	62
Pratt Chuck Co.	81
Pratt & Whitney Co.	2 and 3
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Prentiss Tool & Supply Co.	96
Q. C. Machine Tool Co.	74
Reed Co., F. E.	53
Reed Mfg. Co.	85
Reichhelm & Co., E. P.	68
Ridgway Dynamo & Engine Co.	87
Rivett Lathe Mfg. Co.	3d cover
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Rock Island Tool Co.	85
Rockwood Mfg. Co.	78
Rogers & Hubbard Co.	82
Rogers Wks., John M.	62
Root Co., C. J.	93
Roth Bros. & Co.	88
Safety Emery Wheel Co.	95
Saunders Co., James	66
Saunders Sons, D.	72
Sawyer Gear Wks.	90
Schieren Co., Chas. A.	70
Schmitz, August	70
Schuchardt & Schutte	62
Schumacher & Boye	9
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Sellers & Co., Inc., Wm.	30
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Sibley Mch. Tool Co.	70
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Slate Machine Co., Dwight	70
Sloan & Chace Mfg. Co.	58
Slocomb Co., J. T.	63
Smith, Chas. F.	74
Smith Countershaft Co.	29
Smith & Mills	98
Smith Co., Wm. J.	101
Spacke Mach. Co., F. W.	92
Springfield Mach. Tool Co.	15
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Standard Engineering Works	76
Standard Gauge Steel Co.	85
Standard Tool Co.	67
Stark Tool Co.	76
Starrett Co., L. S.	49
Steptoe Shaper Co., John	75
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Sturtevant Co., B. F.	28
Tabor Mfg. Co.	77
Taylor & Fenn Co.	64
Taylor-Wilson Mfg. Co.	91
Toomey, Frank	97
Triumph Electric Co.	88
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Tudor Mfg. Co.	102
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Von Wyck Mach. Tool Co.	75
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Whitman & Barnes Mfg. Co.	59
Whitney Mfg. Co.	41
Whiton Machine Co., D. E.	80
Wiley & Russell Mfg. Co.	69
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Williamson Vise Co.	85
Wilmarth & Morman Co.	94
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Woodward & Powell Planer Co.	62
Worcester Machine Screw Co.	76
Wormer Machinery Co., C. C.	98
Yale & Towne Mfg. Co.	79

Classified Index to Articles Advertised

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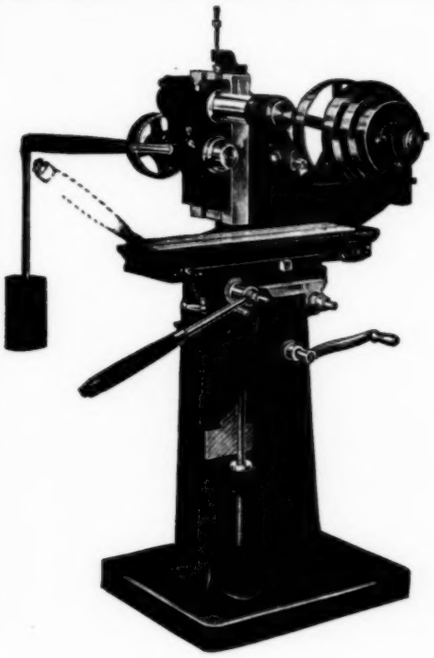

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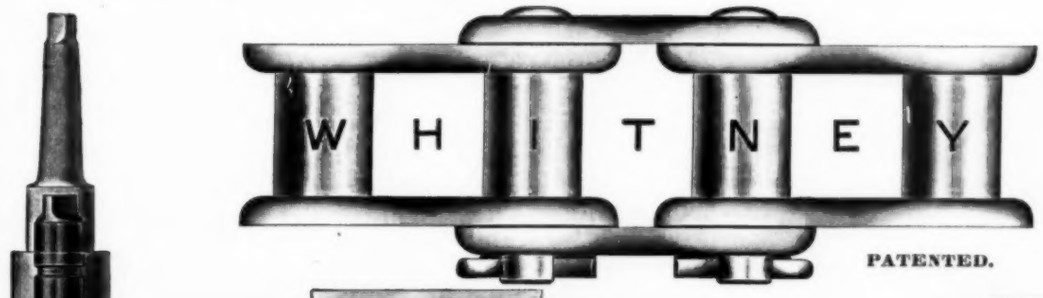

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Crescent Forgings Co., Oakmont, Pa.
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Niles-Bement-Pond Co., New York.
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Obermayer Co., S., Cincinnati, O.
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Cleveland Twist Drill Co., Cleveland, O.
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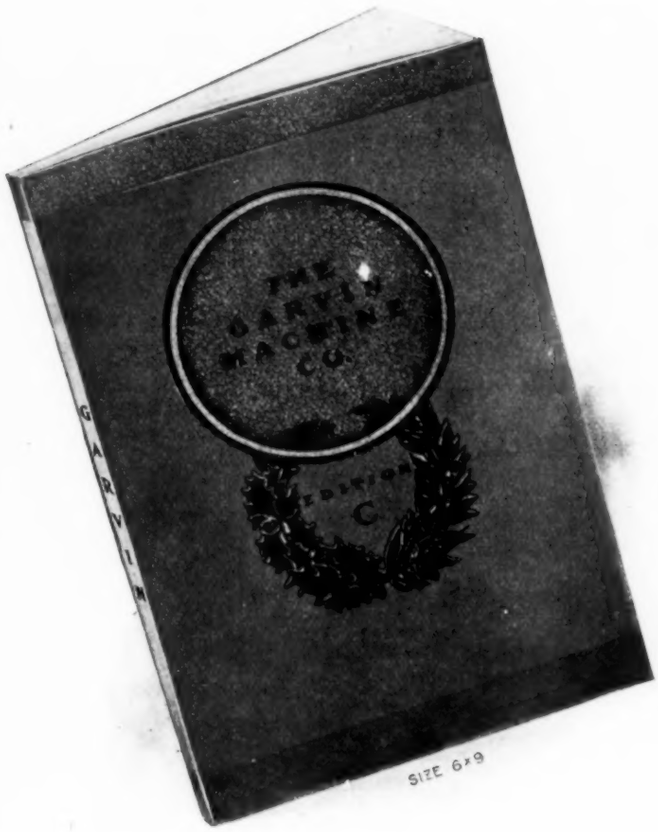

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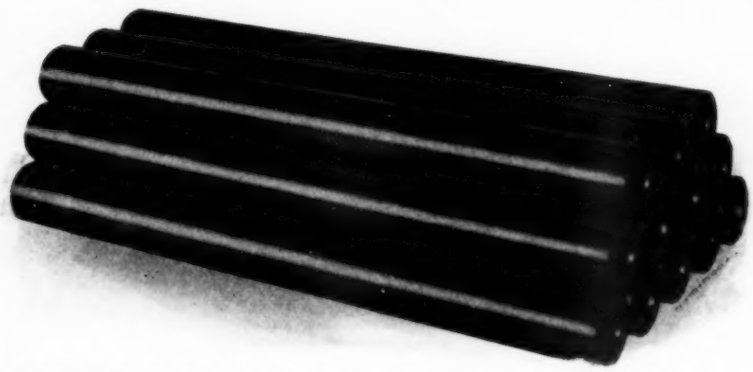

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Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.

Gear Cutting Machinery —*Continued.*
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees-Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburg & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wo k, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg.Co.,Madison, Wis.

Generating Sets—*Continued.*
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. P., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter
Bath Grinder Co., Inc., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Dock Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill
Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife
American Wood Working Mchy. Co., Rochester, N. Y.

Grinders, Knife—*Continued.*
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S Electrical Co., Cincinnati, Ohio.

Grinders, Saw
Tindel-Morris Co. Eddystone, Pa.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co.. Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc.. Wm.. Philadelphia, Pa
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding or Polishing Machinery
Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G.. Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Burk Machy. Co., Cleveland, O.
Chicago Machine Tool Co., Chicago, Ill.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Machine Co., Providence, R. I.
Gardner Mach. Co., Beloit, Mich.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Monarch Emery & Cor. Wheel Co., Camden, N. J.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Grinding Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.